SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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FRIDAY, JUNE 21, 1901.

CONTENTS:

The American Association for the Advancement of Science 961
A Kinetic Theory of Evolution: O. F. COOK 969
Miles Rock: WILLIAM EIMBECK 978
Otto Lugger: DR. L. O. HOWARD 980
Scientific Books:—
Pound and Clements on the Phytogeography of Nebraska: PROFESSOR ARTHUR HOLLICK. *Simpson's Synopsis of the Naiades:* PROFESSOR T. D. A. COCKERELL 981
Scientific Journals and Articles 984
Societies and Academies:—
Philosophical Society of Washington: CHARLES K. WEAD. *Torrey Botanical Club:* MARSHALL A. HOWE. *The Academy of Science of St. Louis:* PROFESSOR WILLIAM TRELEASE 985
Discussion and Correspondence:—
Remarkable Discoveries. An Earthwork Discovered in Michigan: HARLAN I. SMITH. *Physiology in the Schools:* PROFESSOR S. W. WILLISTON 987
Shorter Articles:—
What is Life? PROFESSOR JOSEPH LE CONTE. *A 'Sand Bow':* PROFESSOR JAMES E. TALMAGE 991
Notes on Inorganic Chemistry:—
Platinum in Antiquity; Lead in Pottery Glazes; Osmic Diffusion of Vanadium: J. L. H. 993
Current Notes on Meteorology:—
Annals of the Mont Blanc Observatory; The Moon and the Weather; Notes: R. DE C. WARD 993
Scientific Positions Under the Government 994
The American Association 995
Convocation Week 996
Scientific Notes and News 996
University and Educational News 999

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

A NATIONAL association for the advancement of science occupies at the beginning of the twentieth century a dominant position. The greatest achievement of the nineteenth century was the progress of science; its most definite tendency was towards the voluntary organization of individuals for the accomplishment of certain ends. The advance of science, the movement that is of the greatest importance for civilization, requires for its guidance the strongest association of individuals. Such an association will certainly arise, and will develop from existing institutions.

The organization of science in America has progressed parallel to the advance of science. Local societies concerned with the whole field of knowledge, and especially with its utilitarian aspects, were first established in Philadelphia, in Boston and in other cities. These societies were modeled on the similar institutions of Europe; the Philosophical Society of Philadelphia following the Royal Society of London, and the Academy of Arts and Sciences of Boston, the Paris Academy of Sciences. As centers of scientific activity increased in number,

as the postoffice and railways developed, as general scientific journals were established—*The American Journal of Science* began publication in 1818—the need of a national organization was felt, and here again the older nations had established the precedent. The meetings of German scientific men and physicians began in 1828, and the British Association for the Advancement of Science was established in 1831. An Association of American Geologists and Naturalists was organized in 1840, and became the American Association for the Advancement of Science in 1848.

Fifty years ago the sciences were comparatively undifferentiated. Special societies and special journals were not required. It was possible for students of science and friends of science to meet together and take a common and intelligent interest in the scientific progress of the day. Somewhat later, however, the need became apparent for a more select national society. The local academies in the European capitals had become national institutions in a way that was not possible for the similar societies in the United States, owing to the lack of centralization. Our National Academy of Sciences was organized in 1863 with a membership at first limited to fifty, and still under one hundred. The Academy was intended to be the adviser of the Government in scientific matters, and has to a certain extent fulfilled this function. At first, when there were but few scientific men in the United States and their interests were more or less common, the National Academy was an organization fitted to its environment. But it has scarcely adjusted itself to the growth and specialization in science of the past twenty-five years.

The organization of science that was adequate for the third quarter of the century did not suffice for the fourth quarter. About twenty-five years ago it became necessary to meet the specialization becoming inevitable for scientific advance. Special societies and special journals were organized. The American Society of Naturalists, organized in 1883, and the *American Naturalist*, established in 1867, covered a limited, but still wide, field. Science, a weekly journal, was established in 1883 to keep the sciences in touch with each other and men of science in touch with the general public. The American Chemical Society was organized in 1876, The American Ornithologists' Union in 1883, The Geological Society of America and the present American Mathematical Society in 1888, and there are now national societies for almost every science. Special journals were established during the same period—*The Bulletin of the Torrey Botanical Club* (1870), *The Botanical Gazette* (1876), *The American Journal of Mathematics* (1878), *The American Chemical Journal* (1887), *The American Journal of Morphology* (1887), *The American Journal of Psychology* (1887), *The American Geologist* (1888), *The National Geographic Magazine* (1888), *The American Anthropologist* (1888) and so on, in increasing numbers, to the present time. A similar movement toward specialization is evident in the development of elective courses in our colleges, of advanced work in our universities, and in many other directions.

The American Association for the Advancement of Science did not fail to adjust

its organization to the growth and differentiation of science. In 1875 a formal division was made into two sections, one for the exact and one for the natural sciences, and in 1882 nine sections were established. At this time, when the Association had fitted itself to existing conditions, it enjoyed a most prosperous period in its history, the meetings being large and fruitful. Thus the attendance at Boston in 1880 was 997; at Montreal in 1882 it was 937, and at Philadelphia in 1884 it was 1261. But with the organization and growth of the special societies and journals referred to above, the Association did not maintain its commanding position. The American Society of Naturalists, with a more compact membership, chose midwinter as its time of meeting, and other societies became affiliated with it. The special societies, consisting of groups of experts, appealed to the loyalty of their members more directly than did the larger and more amorphous Association. There was lack of sympathy between these societies and the Association. The attendance at the meetings became smaller, and the total membership decreased. Many eminent men of science and many younger workers were not regularly in attendance at the meetings and were perhaps not even members of the Association. The programs of the sections became heterogeneous and sometimes did not reach a very high standard. The amateur and picnic elements were rather prominent, while at the same time they were mediocre. Many men of science regarded the Association as a survival that had outlived its usefulness.

But to-day no one acquainted with the most recent work of the Association will deny that it has entered on a new period of its history. This began with a change of attitude toward the special societies, replacing rivalry with cooperation. There was much opposition to the plan of letting the American Chemical Society meet in affiliation with the Association, but when this was accomplished chemistry at once became its strongest section. So it has been in other cases, where special societies have met in affiliation with the Association. At the recent New York meeting there were sixteen such societies, including practically all national societies that hold summer meetings. Other improvements in the organization of the Association have been effected. The council has been strengthened and made a truly legislative and executive body. The permanent funds have been increased, and appropriations for research have been granted to committees. Care has been exercised in the election of fellows, and in the admission of titles to the programs. This Journal is sent free of charge to all members, thus increasing and consolidating interest in the Association and in the advancement of science, giving even those unable to attend the annual meetings an adequate return for membership, and tending to unite all men of science and those interested in science in the Association and in the ends that it represents. The last three meetings, held at Boston, Columbus and New York, were all excellent, representing different types adjusted to the occasion and place. The meeting at Denver this year will be equally typical and

equally successful. The membership of the Association is now larger than it ever was before, over eight hundred new members having been elected within the past year.

There is every reason for satisfaction at the present condition and outlook of the Association. But this does not mean that we need not be on the alert to increase its usefulness under the circumstances confronting us at the beginning of the twentieth century. Evolution occurs by natural selection, but with boundless waste, regardless of time and careless of the individual. Human development must henceforth be guided by forethought and reason. It is the object of this article to make some definite suggestions regarding the organization of science in America under the auspices of the Association. They have been carefully considered by some of those most interested in the Association and, though they may not meet with universal approval, they are thought to be worth careful consideration.

The objects of the Association are said in its constitution to be "by periodical and migratory meetings, to promote intercourse between those who are cultivating science in different parts of America, to give a stronger and more general impulse and more systematic direction to scientific research, and to procure for the labors of scientific men, increased facilities and a wider usefulness." This statement may be somewhat systematized and amplified. The legitimate objects of the Association may be said to be (1) the presentation and discussion of research work in the different sciences and the publication of such research. (2) The promotion of research by grants of money and by providing the means for cooperation. (3) The encouragement of addresses, reports and publications on the progress of different departments of science, sometimes of value to the specialist, but more especially important in keeping the sciences in touch with each other. Joint meetings, discussions and publications should be arranged on subjects common to different sciences, relating the pure and applied sciences or concerned with science as a whole. (4) The presentation of such addresses, reports, discussions and publications in a form that will so far as possible keep the general public informed on the advances of science, interest them in the opportunities of scientific work and its needs, and impress on them the dignity and supreme importance of science. Here should be included whatever will secure recruits to scientific workers and the money and support that scientific work requires. (5) Offering an opportunity for men of science in different departments to become acquainted personally and by publication, and encouraging sympathy and loyalty to their common interests, and performing, so far as possible, the same function for scientific men and the intelligent public. (6) The guidance of scientific organization in America, which includes the coordination, establishment and arrangement for the meetings, etc., of special scientific societies; the publication and circulation of scientific books and journals; the place of science in education and all external means for the advancement and diffusion of science; the direction of public opinion and legislation

on science, more especially when connected with the national government, and the different states and municipalities; the promotion of conditions required by science and of reforms recommended by science—in general, whatever will promote the advancement, diffusion and usefulness of science.

1. The first of these functions has in large measure been assumed by the special societies and journals, and this is in accordance with necessary conditions. Special research must be presented before, and discussed by, small groups of experts and must be published in journals that are of interest only to specialists. The special societies have compact organizations; they are most competent to select their membership, to arrange their programs and to conduct their publications. It seems inevitable that the Association must relinquish its function of providing sections for the presentation of special papers, except in the rare case that a special society does not exist and may be formed by the aid of the Association. In a joint meeting of a special society and the corresponding section all the valuable papers will be presented both before the society and the section, and only such papers will be presented to the section alone as the society will not admit. There is, however, no reason why the present general organization should not be maintained, and the papers read before the affiliated societies be made part of the proceedings of the Association. The Association may, however, render important assistance to the special societies in the ways indicated below.

2. The promotion of research by grants of money and by providing the means for cooperation is a function that should be undertaken both by the special societies and by the general Association. The latter is, as a matter of fact, more likely to secure funds for this purpose by bequests and gifts, owing to its national character, its long history and its permanence. It can to special advantage further researches in which more than one science is concerned and in which independent societies might fail to cooperate. Efforts should be made to increase the number of patrons of the Association and to secure bequests and gifts, in order that the American Association may not be behind the British and French Associations, which appropriate annually $5,000 or more for the direct encouragement of research. Invested funds yielding an income for this purpose would add greatly to the stability, influence and usefulness of the Association, and to the interest of the meetings at which the grants are made and the reports of the work accomplished are presented.

3. The special societies may with advantage present addresses and reports on the progress of a science, and, when the societies meet at the same time and place, their value is increased by the opportunity afforded for a larger group to be present. In this direction the Association has, however, an important work. The address of the president, the most eminent man of science in America who has not yet held this office, should be an event of national importance. It should be worth publication, and should be published in full in all the important daily newspapers, as actually happens in

England in the case of the president of the British Association. The addresses of the vice-presidents should be as nearly as may be of the same importance and interest. These should not be addresses such as are presented before the special societies, but should be intelligible and interesting to all men of science and to the great mass of men and women who have had a college education or an equivalent training in affairs. The afternoons through the week might with advantage begin with these addresses, not more than two being given simultaneously, and these might be followed with reports or discussions of problems of general interest. The sectional committees and the council should pay special attention well in advance to the arrangement of a program. Care should be taken, if necessary by invitation to those not members of the Association, to secure the adequate presentation of subjects in which the Association needs strengthening. Thus applied science should be given more prominence than hitherto. Those eminent in public life, in educational work and the like, and distinguished foreign men of science, might be invited to address the Association or to take part in its discussions. Funds should be available to defray at least the traveling expenses of such invited guests.

4. The addresses, reports and discussions should, in part at least, be of such interest as to attract the general public, securing a large local attendance and being reported widely by the press. It is not possible, least of all in a democratic country, for science to isolate itself from common life. There must be special research that can be appreciated only by the expert, but as quickly as possible the progress of science should be made a part of the world's common stock of knowledge. The American Association should be one of the chief factors in the diffusion of science, and its annual meetings should be looked forward to by the general public as the occasion when for its benefit the year's progress in science and the contemporary state of science are exhibited in their outlines and in correct perspective. The meetings should typify the dignity and weight of science, so as to impress these on the minds of all. The sympathy and support of all the people are absolutely essential for science. Only so can recruits for scientific work be secured; only so can endowments and material support be obtained; only so can scientific work under the government be placed on a secure and permanent basis. We have in these needs not only the justification, but the absolute necessity of an Association with a large membership—it should be at least ten thousand—drawn from the intelligent people of the whole country.

5. The social intercourse and personal contact of scientific societies and meetings are among their most important functions. Men in isolation become selfish and incompetent. Even a great genius does not work in solitude, and certainly the ordinary man requires the interest and enthusiasm that is only evoked in the give and take of personal acquaintance and conversation. Eating together, drinking together, smoking together, may have physiological drawbacks, but the psychological stimulus has war-

ranted the origin and survival of these practices. Those studying similar problems, and those working in diverse directions; the university professor, the school teacher and the government officer; those who call their science pure and those who seek to make it useful; the beginners and the old benchers, all should be thrown together, ready to learn and help, to agree and differ. Each should be prepared to profit much, and if need be to sacrifice a little for the common good. The meetings of the Association do, of necessity, accomplish a great deal in bringing men together, but perhaps not all that could be desired. The cultivation of personal acquaintance between professional men of science and the amateur and outsider is also important, but more difficult to manage. The social features of the British Association seem to be more successful than our own. A thousand or more of the leading citizens of the place become temporary members for each meeting, and freely offer entertainments of one sort or another. The social conditions are, of course, different in America, but it seems that the entertainments and excursions might be made more pleasant and profitable in the future.

6. Of all the important functions of a national scientific association, the most essential is the general organization of science. The science of the country absolutely requires a central legislative body. Such bodies exist in other nations, having varying degrees of usefulness, and there is more need of an active and efficient representation of scientific interests in the United States than in any other country. London, Paris and the other European capitals, with their societies, clubs, etc., bring together all the scientific men of the country, whereas here they are widely scattered, and will become still more so as the East loses its intellectual precedence. Washington will doubtless be our chief center for scientific research, but under our system of State governments and with our privately endowed institutions, it is not likely that it will occupy the position of European capitals. The great development of scientific work under the national government, the numerous smaller centers under the State governments at their capitals and universities, the municipalities with their increasing tendency to support museums, libraries, etc., and to undertake functions requiring scientific experts, the great incorporated universities developing special research, the applications of science in industries, transportation, etc.—all these represent an extraordinary activity, and, at the same time, a dispersion of tendencies and interests that require here more than in any country some unifying and centralizing organization. The functions of such a body are only limited by its efficiency. Our government recognizes a division into executive, legislative and judicial functions, but does not recognize the coordinate importance of expert opinion. As the judicatory interprets the laws made by the legislature, so the legislature requires impartial advice and scientific knowledge as the basis of its enactments.

The question now arises as to what body or bodies should perform the functions thus outlined. In the first place, it is evident that we need numerous and partly inde-

pendent institutions. Each university, museum, survey, observatory, botanical garden, laboratory and the like is a unit, requiring its special organization. Each city should have a local academy, or alliance of societies, which in its field should perform most of the functions that we have been considering. Similar academies, or groups of societies, are needed for a State or region. National societies are required for each science. But what should be the national organization that will bring all the local and special societies together, and accomplish for the nation and for science as a whole what these institutions and societies do for a locality or a single science? We have at present the National Academy of Sciences and the American Association for the Advancement of Science, both of which have to a certain extent filled these requirements, but only in a partial and imperfect way. The Academy is legally the adviser of the government, the Association has brought into its organization a majority of the scientific men and many of the scientific societies of the country; but it seems probable that neither a small self perpetuating body of eminent men nor a plebiscite of all scientific men will perform the duties required. Representative government, in spite of its partial failures, is the kind of government under which we should live and must live. We find this most nearly embodied in the council of the American Association. This council might be made the representative body for science in America.

If it be asked what the American Association and its council should do to assume the position assigned to them, the reply may fortunately be made: Let them continue the work that they have already begun. The whole matter is one of attitude and spirit, rather than of constitution and by-laws. Let all scientific men be fellows of the Association, make the members representative of the intelligence of the country, unite all scientific societies and institutions in the organization of the Association, make the meetings important and interesting, let the council assume and deserve authority.

While the position of the Association must depend chiefly on natural fitness and development and on the spirit and character of its members, there are certain changes in organization that deserve consideration. We shall suggest some modifications which appear to be either desirable at present or objects to be kept in view.

Affiliated societies should be represented on the council, and all scientific societies, whether national or local, should be affiliated with the Association. The number of representatives allowed from each society should be proportional to the number of members of the society among the fellows of the Association. For example, each institution having ten fellows might be allowed a representative and an additional representative for each additional twenty-five fellows. This plan includes the representation of local academies, universities, government departments, etc., on the council, but might begin with the societies meeting with the Association, in accordance with an amendment to the constitution now pending. It might be well for the

council to elect each year three additional members to serve for a term of three years. Those so elected would probably be among the most efficient members of the council. The council would thus be considerably enlarged, but its authority would be greatly increased. It is of course understood that the real work of legislative bodies is done by committees, and the committees of the council should be organized with special care.

The executive officer of the Association is the permanent secretary, and his influence should be very great. He should either be paid a reasonable salary, say $5,000, and devote his whole time to the Association and the organization of science in America, or should be, as our present secretary, a man of unusual executive ability, having under him one or two assistant secretaries who should devote themselves to the work. The secretaries of the sections should be among the most efficient members of the sections, and should be elected for a term of three years and reeligible.

The meetings should be more thoroughly organized in advance, more authority being vested in the permanent secretary and council. As suggested above, public lectures and discussions on the important advances and current problems of general interest should be arranged. For example, this year there should be reports on the relation of mosquitoes to disease, on the newly established Bureau of Standards, on the conduct of a national observatory, on the natural history and resources of the West Indies and the Philippines, and, in view of the place of meeting, on mining and irrigation.

The time of meeting has always interfered with success. Men of science will not and and can not come together at midsummer. If a week can be set aside at the beginning of the year, it is probable that the scientific character and weight of the meetings will be greatly forwarded. The importance of obtaining a convocation week in midwinter has been emphasized in a recent editorial (April 26, 1901), and we are now able to report that, of the fourteen universities comprising the Association of American Universities, all but two either already have no exercises at the time or have altered their calendars in the direction of setting aside the week in which New Year's Day falls for the meetings of scientific and learned societies. It might, however, be well to have, say once in three years, a summer meeting in which the social and excursion elements should be emphasized. It must be remembered that the National Educational Association can bring together 10,000 members in this way. Or perhaps, it will be found with experience that the winter meeting is so advantageous that the summer meetings can be omitted altogether. Meanwhile there might be suggested a special meeting at Chicago next year at Christmas time in conjunction with the Naturalists and affiliated societies, the usual meeting at Pittsburg in midsummer, and a meeting of unusual importance at Washington at the end of the year.

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*A KINETIC THEORY OF EVOLUTION.**

IN 1895† the opinion was expressed that the differentiation existing in certain fami-

* Read before the Biological Society of Washington, May 4, 1901.

† *Proc. U. S. Nat. Museum*, 1895, 18 : 64.

lies of Chilopoda represents the results of variation accumulated without the interference of natural selection. In the next year* the same proposition was applied to the class Diplopoda, and studies in other groups, such as the termites, fungi, hepaticæ, mosses, ferns and flowering plants have led to the belief that there is little ground for the supposed stability of organic form and structure which furnished the basis of the doctrine of the separate creation of species, and which still figures as an important postulate in theories of evolution through natural selection. The Diplopoda are one of the many classes of animals and plants in which ecologic relations are essentially different from those of the mammals, birds, and other highly specialized groups upon which evolutionary studies have largely been based. Among the Diplopoda are to be found very few of the adaptations so numerous among the true insects; Diplopoda do not eat each other, and are not eaten by other animals;† their food requirements are not specialized, and decaying vegetable matter is generally abundant far in excess of their needs. There is seldom a suggestion of a struggle for existence or of other conditions indicating an active principle of selection. At the same time there is no lack of morphological differences, and while the present or past absence of selective influence in any particular character cannot, of course, be demonstrated, the phylogenetic, biologic and ecologic unity of the group, when contrasted with its structural and evolutionary diversity, seems to justify the opinion that in this class, at least, evolution is a kinetic phenomenon or active process of organic change, instead of the result of a passive subjection to external interference in otherwise stable conditions.

* *American Naturalist*, 1896, 30 : 682.

† Science, N. S., Vol. XII., October 5, 1900, p. 518.

EVOLUTION BY INTEGRATION.

Examples of groups of characters which it seems impossible to look upon as of selective origin have been noticed in another place.* Moreover, it is scarcely necessary to detail particular instances, since for a proposition partaking of the nature of a general law every biologist should find ample supporting evidence inside the field of his own specialty. Kinetic evolution is, indeed, nothing new, and requires for its formal recognition little beyond the most obvious facts of natural history; doubtless it would have been appreciated and accepted years ago had not makers of static theories protected themselves against so simple an inference by inventing the so-called principle of panmixia, under which it is argued that spontaneous progressive change is impossible in a large group of individuals, because fortuitous variations occurring simultaneously in all directions are brought back to a stable average by intercrossing.

In reality, however, this proposition is worthy of little of the deference due to a mathematical axiom; biologically it rests on unproved and apparently unprovable assumptions. We have by no means ascertained that the individuals of a species tend to vary equally in all directions with respect to all their characters; on the contrary, some variations are much more common than others. We have not ascertained that the crossing of individuals showing different variations always results in average offspring; we know instead that the next generation often exceeds both its parents in the accentuation of some new characteristic. In its logical development panmixia, if true, would constitute a demonstration that individual variation acting through heredity cannot contribute to the evolutionary progress of a species; it is as

* 'The Diplopod Family Oxydesmidae,' a paper prepared for the Proceedings of the U. S. National Museum.

though individual influence were a wave raised by a pebble, and not a permanent elevation of level. Individual differences could in this view affect the evolution of species only when interbreeding is prevented by some form of isolation, a supposition which has received apparent support from the finding of many distinct species in small islands or other circumscribed localities. That isolation tends to the rapid *differentiation of specific types* affords, however, no proof that *progressive change* is due to isolation, geographical or selectional. That a certain peculiarity is manifest in all the individuals of an insular or strictly circumscribed species may mean, not that all the individuals are descended from a single peculiar ancestor, but that the change tendencies which have originated in this locality have been confined to it, and have not been able to propagate themselves beyond the natural barriers.* In the absence of such limits specific differentiation might not have taken place, but evolutionary progress might have been greater by reason of access to more varied developmental tendencies. Specific differentiation thus affords but little indication of the rate or nature of evolutionary progress, which often appears not to be the result of isolation at all, but rather of the aggregation and integration of individual variations welcome to the organic constitution. In this aspect of the subject isolation may be viewed as the absence, rather than as the result, of selection.

* The stability or fixity of type which has been ascribed to small segregations of plants and animals is only relative, even under careful artifical selection, and from the standpoint of biological history is to be interpreted as uniformity rather than as permanence. Among the molluscs, which have been supposed to furnish examples of great permanence, very diverse animals are now known to inhabit shells of extreme similarity. Evidently the external skeleton is not an adequate index of evolutionary status: in some families variation seems to have principally affected the shells, in others the softer parts.

Species, which have been thought to support the opinion that selection brings about evolution by inducing various degrees and kinds of isolation, can often be much more rationally interpreted as instances of the manifestation of spontaneous developmental tendencies. Groups like the Diplopoda illustrate the infinity of combinations of characters possible without the assistance of any of the influences commonly invoked to explain the specializations of the more adaptive organisms, and thus permit us to realize that evolution is one of the causes, instead of a result, of biological isolation, the effects of which are probably limited to specific differentiation.

To have confidence in organic evolution accomplished by selection and isolation in the presence of an efficient panmixia would require at least double the credulity needed to equip the earth from the original pairs of the Garden of Eden or of Noah's Ark, since the ancient accounts provided two parents for each species while the modern begins with one, the offspring of which must be placed under such conditions that they are prevented from mixing with the parental type, either by means of geographical separation or through circumstances which give the variety immediate and exclusive advantage over the older forms. The only alternative would involve the origin of species from sports so extremely divergent that their offspring would remain distinct after considerable dilution with the parent form. The maintenance of such differences through the prepotency of new types, in accordance with the kinetic view, could not, of course, be invoked under theories accepting panmixia.

Moreover, it should not be forgotten that all segregations of small numbers of individuals involve the necessity of close breeding, which has been found in domesticated animals and plants to lead in many instances directly toward abnormal and

even pathological characteristics, and which is also commonly recognized as weakening vitality and vegetative strength. Thus many high-bred varieties of plants are nearly or quite seedless, while in others the germinating power of the seed is very low, facts that afford a strong indication that general evolutionary progress has not been greatly favored by segregation.

Although the breeding of domestic animals and plants has generally been directed toward the accentuation of some one feature or limited group of characteristics desirable for economic reasons, it should be remembered that, in nature, evolutionary progress must carry with it improvement in total organic efficiency, which in turn depends upon almost an infinity of morphological and physiological coordinations, the perfection of which would be assisted rather than hindered by the access to a great variety of evolutionary tendencies or suggestions.

From the evolutionary standpoint a species is not a definition or a complex of characters, more or less important, but a group of organic individuals which stand in a definite biological relation of reproductive accessibility. Species do not arise and are not separated in nature primarily by the degree or amount of difference which may exist between individuals; in some groups species contain greater diversities than appear elsewhere between genera, families or orders. Interbreeding prevents the subdivision of species, but at the same time conduces to variety instead of maintaining stability. Species become distinct in nature not only when the component individuals are separated by geographical or other forms of isolation, but accumulated variations may themselves bring about isolation when evolutionary tendencies become so divergent that further coordination is difficult, and interbreeding ceases. Evolution is thus a process of integration rather than of segregation, and organic progress, like intellectual and social advancement, is not an individual phenomenon, but the accumulated result of individual contributions which are not lost, but saved, by interbreeding or communication to others. Isolation permits the accentuation of individual peculiarities, but does not on that account conduce to intellectual or social development; selection may encourage specialization, but it often limits the field of subsequent changes and adaptations necessary for the perpetuation and continued welfare of the species.

The various forms of selection and isolation represent, as it were, the outside of evolution, the points at which it is affected by external accidents. Organic development is not, however, a passive, but an intensely active process; selection and isolation have not caused evolution, but are among the conditions under which it sometimes proceeds.

The crossing of geographically distinct species often results, not merely in the production of intermediate forms, but in new types having characters not represented in either of the parents, and since the same result often follows the crossing of divergent forms of the same species, we have a further reason for believing that progressive change is not dependent upon, but may even be impeded by, selection and isolation, and that interbreeding rather than segregation is favorable to evolutionary progress. Static theories have thus reversed the true functions and effects of panmixia and isolation.

DARWINISM AS A STATIC THEORY.

Phylogeny and ecology were combined by Darwin as different sides of the same phenomenon, and environment was held at once to cause variation and to produce indefinitely extensive changes by means of it —a theory here described as static because

it predicates the normal stability of organic series.*

The configuration of a valley may determine the banks of a river which flows through it, but the valley does not cause the water to run down hill. In the absence of this property of water valleys would be quite powerless to 'give rise' to rivers. Similarly, it is true that environment influences organic evolution; it may accelerate or retard, deflect or even set absolute barriers to change, but these facts afford no reason for believing that selection represents a biological force. The vital river, when unconfined, is in motion; change is a law of organic succession; evolution is a property of protoplasm.

Some rivers have direct courses, deep channels and swift currents; the water reaches the sea without much loss of time; with such streams is comparable the evolution of the organic groups which an active selection has kept well within the lines of utility, whose functional organization is so perfect that a useless structure or an unprotective color is looked upon as an anomaly requiring special explanation. There are, however, other rivers the waters of which give no suggestion of haste: they meet innumerable turns, eddies and backsets, they are divided by islands, and often overflow the land. With such rivers may be compared the evolution of groups like the Diplopoda, not confined by too exact requirements of utility, and hence the better able to manifest the natural tendency to indefinite change.

Darwin and Wallace recognized the fact that a species does not constitute a single morphological point, but that the projection of its characters requires a surface of appreciable area. And assuming that there is a tendency or law by which such an area remains even approximately constant in size, they found that it could be given a progressive motion by taking away from one side while permitting the other to grow out. Thus it appeared possible by predicating external causes to explain evolutionary progress with but a slight readjustment of the traditional static view of organic

* "But let the external conditions of a country alter * * * the original inhabitants must cease to be as perfectly adapted to the changed conditions as they were originally * * * such changes of external conditions would, from their acting on the reproductive system, probably cause the organization of those beings which are most affected to become, as under domestication, plastic. Now, can it be doubted, from the struggle each individual has to obtain subsistence, that any minute variation in structure, habits or instincts, adapting that individual better to the new conditions, would tell upon its vigor and health? * * * Each new variety or species, when formed, will generally take the place of, and thus exterminate, its less well fitted parent. This I believe to be the origin of the classification and affinities of organic beings at all times; for organic beings always *seem* to branch and sub-branch like the limbs of a tree from a common trunk, the flourishing and diverging twigs destroying the less vigorous, the dead and lost branches rudely representing extinct genera and families."

Quite as definitely did Wallace state the same proposition in controverting the somewhat more narrowly static idea that the variations of species are limited, as it were, to fixed points beyond which they cannot go in nature, or to which they must return if differentiated from the wild type by artificial selection.

"But * * * there is a general principle in nature which will cause many *varieties* to survive the parent species, and to give rise to successive variations departing further and further from the original type, and which also produces in domesticated animals the tendency of varieties to return to the parent form. * * * Granted, therefore, a 'tendency' to reproduce the original type of the species, still the variety must ever remain preponderant in numbers, and under adverse physical conditions *again alone survive*. But this new, improved, and populous race might itself, in course of time, give rise to new varieties, exhibiting several diverging modifications of form, any one of which, tending to increase the facilities for preserving existence, must, by the same general law, in their turn become predominant. Here, then, we have *progression and continued divergence* deduced from the general laws which regulate the existence of animals in a state of nature, and from the undisputed fact that varieties do frequently occur."

life, a view which thus persisted and is still generally held.

Subsequently, both Darwin and Wallace admitted progressive variation without natural selection, which was considered to be but one of several factors contributing to evolution. The original statement, however, continues to represent Darwinism in the scientific world, and, as has been well said,* "The biologist of to-day is more Darwinian than Darwin, and explains on the Darwinian hypothesis even those cases which had presented difficulties to Darwin's own mind." This tendency signifies that the inadequacy of all other explanations has become more and more thoroughly realized, thus causing a return to Darwin as the author of the only real contribution to the study of biological causes. The static or selective theory of evolution has, however, attained its present popularity, not because it has been shown to have any universal application in nature, but because it has remained the only suggested explanation which seemed to be supported by definite and particularized phenomena.

VARIATION AND CONJUGATION AS KINETIC PHENOMENA.

It is probable that in the study of biological motion it will be found desirable to distinguish at least four types of variation or kinds of differences between closely related organisms. Some modifications may be described as mere chemical or physical reactions to definite substances, forces or conditions; † some are more clearly pathological and are the result of inherent weakness or derangement of the organism; while others are normal vibrations or fluctuations of form, size, color or other characteristics having, perhaps, no very definite single cause, nor any pronounced tendency to repeat themselves. Essentially different, though often confused with one or the other of the above, are the peculiarities which represent lines of change or divergence, upon which the organic series if unhindered may proceed with no diminution, but rather with an increase of structural and physiological efficiency, and often with persistence and rapidity. To this class belong the 'sports' which come true to seed and yet show no signs of debility, and which, though crossed with the parental type, impress their characters upon a large majority of the offspring. In other words, variations of this kind are prepotent because they open avenues of advance and adjustment welcome to the organism and necessary to the maintenance of the efficiency of protoplasmic structure and function.

Variation and conjugation may thus be supposed to minister to the same requirement of the protoplasmic organization. There is little or no warrant for the current belief that variation and heredity are phenomena essentially connected with sexual reproduction, and thus explainable through a knowledge of the structure and mechanism of conjugating cells. In final analysis reproduction is not a sexual but a vegetative process. Because in some groups the conjugation of nuclei is an indispensable preliminary to reproduction,* the most

* Haycraft, 'Darwinism and Race Progress,' London, 1900, 28.

† According to Professor Osborne: "When the pale *Proteus* is taken from the Austrian caves, placed in the sunlight, and in the course of a month becomes darkly pigmented, there are two interpretations of this pigmentation; either that we have revived a latent character, or that we have created a new character." *American Naturalist*, May, 1899, p. 431. It would seem, however, that this experiment may prove neither of these alternatives, but merely that the skin of *Proteus* is capable of the photic reaction which generally influences the formation of pigment.

* Science, N. S., 1900, XII., pp. 940–946. In this presentation of Professor Hertwig's views the issue is still obscured by a residue of the former terminology. Thus on page 943 we read that "the sexual reproduction of Metazoa is a continuation of the method of reproduction in the Protozoa, while the budding and

intimate of causal relations have been inferred, in spite of the existence of many forms of reproduction not so preceded. From the morphological standpoint there is every gradation from parthenogenesis or the development without fertilization of cells which are normally fertilized, to the simplest case of plants multiplied by branching root-stocks. From the evolutionary standpoint such differences are of comparatively little moment; all organisms seem to be variable, whatever their methods of reproduction. There is, however, a general law that the more specialized the organism and its reproductive processes the smaller are the probabilities that conjugation can be dispensed with. It is as though complexity of organization required a higher tension of the protoplasmic structure which could not be maintained without conjugation, rest or change. Thus among animals of high organization there are but two conspicuous instances of normal parthenogenesis, the bees and the plant-lice, and in both of these the generations, sexes or castes produced without conjugation are inferior, specialized and unable to maintain the existence of the species. The relative frequency with which parthenogenesis and asexual reproduction are maintained among the lower animals and plants, in connection with parasitic or saprophytic habits suggests the further possibility that protoplasmic compounds of high complexity may be utilized as partial or complete substitutes for conjugation. Cytologists might thus find it worth while to ascertain, if possible, the exact nature of the protoplasmic relations between parasite and host.

fission of Metazoa are adjustments having only an outward resemblance to the budding and fission of Protozoa." While processes, like organisms, must have a common origin if genuine homologies are to be established, it seems obvious that on the plane of Professor Hertwig's discussion conjugation and reproduction are directly comparable throughout organic nature. Current errors are not so much in the direction of mistaking the nature of the processes, as in failing to observe that what is termed 'asexual reproduction' in simple organisms is generally called 'growth' in the more complex. From the cytological standpoint there are two sets of phenomena in both plants and animals, conjugation or fertilization and fission or growth by cell multiplication. The association and specialization of cells in compound organisms (Metazoa and Metaphyta) have given rise to a great variety of independently acquired reproductive adaptations superposed upon conjugation and fission, but different in category, and having neither phylogeny nor homology with those processes.

CHEMICAL AND MECHANICAL THEORIES.

Chemical theory has advanced to the point where different qualities of compounds are explained by reference to positional relations between the component atoms, but behind this lies the question of the nature and qualities of the elemental substances themselves. By common consent the molecular constitution of protoplasm is admitted to be almost unimaginably complex and still utterly inaccessible and intractable from the chemical side. Nevertheless, we recognize that the qualitative or potential differences of protoplasm extend not only to species, but actually to individuals, and yet some biologists are attempting to grasp these ultimate differences before solving the problem of the physical and the chemical groundwork of protoplasmic structure.

A solution of evolutionary problems on this basis can be expected only by those who remain regardless of the fact that the already insurmountable physical and chemical difficulties would be, as it were, multiplied by infinity under theories which imply that not only the complexities of the organic constitution, but also the endless details of individual difference, are symbolized, materialized or predetermined by positional or other relations of atoms, to say nothing of the chromosomes or granules which some have taken to be the actual organs of protoplasmic foreordination. Similar theories invented by theologians

have been set aside by biologists as crudely anthropomorphic. In reality the immediate causes or mechanisms of evolution are as completely unknown as those of the other spontaneous or active properties of protoplasm. Until more light can be shed upon the physical and chemical how and why of assimilation, growth, irritability, motility and reproduction, we can scarcely expect to attain an adequate comprehension of the process which represents a continuous summary of these organic activities.

The center of activity or citadel of the protoplasm of cells is located, evidently, in the nucleus, and there are also reasons for believing that the number, position or other relations of the chromatin bands have important functions in the processes of cell division, and possibly also in determining the relative preponderance of the parental influences. But such facts are very far from proving that either heredity, variation or the resultant evolutionary motion is controlled by purely cytological processes, or that there is any such thing as a 'hereditary mechanism.'* Developed to their logical conclusions, theories of determinants coincide with Nägeli's attempted deduction of the organic universe from the chemical and physical structure of protoplasm, in ignoring the fact that even in the highest organisms cells are still cells, and that from the cytological standpoint they are not improved, but degraded by specialization. A complex organism is more than the component cells, and evolution is not only a cytological, but a social and supercellular process. Life itself is the 'unknown factor,' or neglected cause, which vitiates the theories of those who expect a complete expression of organic phenomena in terms of current conceptions of matter and molecular and atomic forces.

Under cytological or intracellular theories the evolution of unicellular organisms must involve principles fundamentally distinct from those required in multicellular groups, with a similar gap intervening when compound individuals and social units are being dealt with. But if we look upon evolution as a normal property of protoplasm no such complications need be met, higher acquirements being added by gradual superposition. In nature, moreover, there are no breaks in the chain which connects simple and complex types of individuality. Beginning with the absolute individuality of some unicellular organisms where each cell may compete directly with every other cell, we have all grades of association and adhesion; also when the individual compacted of similar and equivalent cells is traced to the point where it begins to manifest increasing differentiation of parts into special tissues and organs. Equally perfect is the series of social adaptations and instincts, through simple aggregations or flocks, to the complex caste differentiations of the highly organized colonies of the social hymenoptera and termites.

A general law of biological evolution must embrace the morphology, physiology, ecology, psychology, ethnology and sociology of the entire organic series, to say nothing of still more general or philosophical applications. But while any process of gradual change and readjustment would bear the teleological interpretation of natural selection, that theory does not furnish an adequate explanation or supply causal connection for the succession of phenomena encountered in any department of biological study.

*The well-known phenomena of asexual reproduction, parthenogenesis and replacement of lost parts should have saved us from theories of localized and mechanical heredity, but if further proof is needed it is now available in the experiments of Loeb in artificial parthenogenesis, those of Delage and others with enucleated fragments of eggs, and those of Mr. A. J. Pieters in growing normal plants from pieces of cotyledons.

COROLLARIES AND CONCLUSIONS.

It will readily be understood that the center of gravity of evolutionary theories will appear to change on admitting the correctness of a kinetic view, and this not only in strictly biological, but in other related lines of thought. Time and space are alike wanting for the canvass of such readjustments; it is possible in the way of summary and conclusion only to notice in a brief and disconnected manner a few of the corollaries and subsidiary theories accommodated or suggested by the belief that evolution is a general property of protoplasm, and not the function of a special mechanism or a reaction to external stimuli.

The differentiation of species is a phenomenon distinct from evolutionary progress; isolation may conduce to the former while retarding the latter.

Selection, acting through isolation, affects evolution by influencing the direction and rate of progress with respect to particular characters; that species may originate through natural selection does not, however, prove that selection is a cause of organic change or of evolution.

Variation furnishes the differentials of which evolution is the integration; selection and isolation may affect the equation either as positive or as negative quantities. Specific differentiation is a direct function of selection and isolation, but evolutionary progress is often an inverse function.

Groups having large, complex and variable species, or numerous closely related species, are in a state of active evolution, while those in which species and genera are few, small and uniform have passed the zenith of their evolutionary history. Thus the compositae and hymenoptera are prosperous, while the cycads and diplopods are on the decline. Primitive characters are to be sought in insular or circumscribed species rather than among related continental or widely distributed types. Static theories would compel contrary inferences.

In large and widely extended species uniformity or diversity of characters depends upon relative facility of distribution; the more rapidly new characters can be disseminated the greater the uniformity of the species. Such uniformity should not, however, be interpreted as stability, which may be relatively greater in locally diversified species.

That diversity is not conditioned upon segregation, but is distinctly favored inside the limits of species, also seems obvious from the differentiations of sex, caste, dimorphism and other similar specializations. Moreover, these phenomena do not represent a single device or adaptation, but have appeared independently in many natural groups.

The relative importance of natural selection has differed greatly in the evolution of the various natural groups; in a general way it may be thought of as proportional to ecological diversity.

Evolution is not a special process or function, but appears in all types of individuals from the unicellular through the various grades of polycellular and compound organisms to the caste-differentiated colonies of the social insects; it accompanies both sexual and asexual methods of reproduction, seedless plants and insects derived from unfertilized eggs continuing to vary and differentiate.

Evolution is both cellular or cytologic and supercellular or organic; the former appears in simple types and in the component cells of higher groups; the latter is a social phenomenon having no obvious or necessary connection with cytological processes.

In some groups it has been ascertained that evolutionary characters or conditions which first appeared in the adult are subsequently passed back into preliminary or

embryonic stages; such facts do not, however, establish a general law of retrogression or recapitulation, since the metamorphoses of insects and other similar phenomena show that evolutionary deviations and adaptations may occur at any stage in the life histories of organisms.

The adaptability of an organism is in general inversely proportional to the degree of ecological specialization already attained. Accordingly, highly specialized types tend to become restricted and to disappear, while the more primitive may persist and give repeated demonstrations of the evolutionary tendencies or variational possibilities of the group.

Parallel evolution is thus not necessarily adaptive or mimetic, and may often be interpreted as an indication that a tendency to a particular variation may outlive specific differentiation and become similarly accentuated, even in groups in which long separation has permitted the accumulation of many differences in other characters.

From the standpoint of a kinetic theory the inheritance of acquired characters becomes a purely formal question; indeed, it may be said that the origination and inheritance of characters are but different statements of the same fact, since characters originate and are extended because of the same inherent tendency to change.

The continued differentiation of vestigial organs and structures shows that there is no essential connection between evolution and use. The vast majority of variations and specific differences are also obviously non useful; they arise, are prepotent and are perpetuated because they are different and new, rather than through any external influence or necessity.

All hereditary characters are acquired, but not all acquired characters are hereditary. There is no reason to believe that any are hereditary which have not been acquired through the assistance of normal variation. Mere mutilations or reactions to external conditions are not hereditary. Evolution is essentially a process of acquiring characters, but no direct nexus between environment and heredity has been demonstrated, and none is necessary under a kinetic theory.

A kinetic theory enables us, in short, to recognize the varied facts of evolution without doing violence to any of them. While holding that all evolutionary changes are essentially the same in having an internal and spontaneous origin, we are still not compelled to deny that adaptations have been influenced by external agencies. Selection represents, however, not the causes, but the external incidents of evolution. Persistent variation should be compared with the main spring, selection to the balance-wheel, of an organic creation which progresses because new characters and powers are welcome, rather than because old types are exterminated.

O. F. Cook.

Washington, D. C.

THE LATE MILES ROCK.

Miles Rock, a notable scientist, born at Ephrata, Lancaster county, Pennsylvania, October 10, 1840, died on January 29, 1901, in his sixty-first year.

During boyhood he attended the public schools of Ephrata, and later the Lancaster High School, fitting himself for Franklin and Marshall College. At the outbreak of the Civil War he was pursuing his studies at this college; but love of country and the trend of public spirit at the time prompted him to join the Pennsylvania Volunteers and proceed to the seat of war. He remained a soldier at the front until the close of the war; and it is significant of his character that he carried in his knapsack a copy of Gray's 'Manual of Botany,' and employed his leisure in collecting and analyzing the plants observed in the campaign.

At the close of hostilities he entered Lehigh University, which Asa Packer, the philanthropist of Lehigh Valley, had just founded and established at South Bethlehem; he graduated as Civil Engineer with the first class of Lehigh in 1869. Of the three young men who entered Lehigh in 1866 and formed the first graduating class of this now famous institution of learning, two are gone—J. H. Hind Corbin, and now Miles Rock; the third, C. E. Ronaldson, a mining engineer, of Philadelphia, survives. Mr. Rock's graduating thesis was on 'Forest Trees'; and he treated the theme in physical, moral and scientific aspects, evincing thorough familiarity with the subject, and such originality and breadth of thought as to gain the hearty approbation of his fellow-students, with whom he was highly popular. Immediately after graduation, he became instructor in mineralogy and geology at the University.

In 1870 Mr. Rock married Miss Susan Clarkson, and subsequently accepted a position as astronomical assistant to Dr. B. A. Gould, director of the Cordoba Observatory, Argentine Republic. This he retained until 1873, participating in the Durchmusterung or Zone work, undertaken by Dr. Gould, and in mapping the multitude of star observations of the southern heavens. The results of his astronomical work at Cordoba are embodied in 'Uranometria Argentina,' published in Buenos Ayres in 1879.

In the autumn of 1874, Mr. Rock cooperated with Commander F. M. Green, of the U. S. Navy, in determining latitudes and longitudes, by means of submarine cables, in the West Indies and Central America, for the use of the Hydrographic Office. He was occupied in this work until 1877. During the two years immediately following he served as a field astronomer in the U. S. Geographical and Geological Surveys west of the 100th meridian under Lieutenant George M. Wheeler, of the U. S. Engineers, and determined latitudes and telegraphic longitudes in several of the western states and territories. On July 1, 1880, he was appointed assistant astronomer at the U. S. Naval Observatory, and served acceptably in that capacity at the transit circle under the immediate direction of Professor John R. Eastman, U. S. Navy. In 1882 he was detailed to aid Professor Lewis Boss in the observation of the transit of Venus at Santiago de Chile in December of the same year.

On the recommendation of the U. S. Government, Mr. Rock was appointed astronomical engineer for Guatemala in 1883; and for fifteen years he served as Chief of the Guatemala Boundary Commission, charged with the duty of determining and locating the disputed frontier between Guatemala and Mexico. To his technical knowledge, diplomatic skill, strong sense of justice, and invincible courage, Guatemala unquestionably owes the retention of her rights in certain valuable lands in the district of Peten, which had been claimed by Mexico, even to the point of threatened hostilities.

As a Commissioner Mr. Rock was highly regarded by the Guatemalan authorities, especially as he seldom failed to evince a ready and deep interest in the people, and in the development of the resources of the republic. During his incumbency he also served as the delegate of the Guatemalan Government to the International Congress at Washington in October, 1894, which adopted for the nations represented the uniform zero-meridian of Greenwich for maritime purposes.

On the completion of his official work for the Guatemalan Government, in 1898, Mr. Rock remained in the country, devoting himself to private interests.

Mr. Rock never ceased to take a keen interest in the affairs of his *alma mater;*

and on the formation of a Lehigh alumni association at Philadelphia in 1870 he was chosen its first president, and a few years later was appointed an honorary alumni trustee. He last visited Lehigh on the occasion of a reunion of the alumni in 1897, when he delivered an address. He was a frequent contributor to the collections of the several scientific departments of the University, and many of his collections are preserved in the University Museum. A nominal resident of, and frequent visitor to, Washington, he took a prominent part in the scientific activities of the Capital. He was one of the founders of the Anthropological Society of Washington, and of the Cosmos Club; he was also a member of the Washington Academy of Sciences and of the National Geographic Society.

Mr. Rock's death was sudden, resulting from acute gastritis followed by heart failure. The sad intelligence was reported to the State Department on the second of last February, by United States Consul-General McNally of Guatemala.

In recognition of the great worth of the services which Mr. Rock had rendered to Guatemala during the years of his official activities there, the Government of that country took charge of the funeral, and he was buried in the cemetery of Guatemala City with public honors under the personal direction of President Cabrera. In their official reports to the Department of State, the representatives of this country in Guatemala showed that Mr. Rock was universally mourned, and that no such funeral honors had ever before been accorded to anyone but the highest officials of the country. The most affecting if not the most impressive feature was the attendance of hundreds of poor natives, who had known Mr. Rock and experienced his never-failing kindness and generosity, who silently and tearfully followed him to his last resting place. Simple in their own lives and thoughts, they paid the only tribute at their command to the man whose singleness of purpose, love of justice and warmth of heart endeared him to all who knew him. Peace be to his ashes!

Mr. Rock leaves a widow, a married daughter, Mrs. F. L. Ransome, and a son, Alfred Mayer Rock, all of whom reside in this city.

William Eimbeck.

Washington, D. C.,
April 22, 1901.

OTTO LUGGER.

Otto Lugger, State Entomologist of Minnesota, who died May 21, from pneumonia, after a very short illness, was one of the most widely known of the many Americans of German birth who have obtained high scientific reputation in this country. He was born at Hagen, Westphalia, September 16, 1844. His father was a professor of chemistry in a Prussian university. Lugger was educated in Hagen, and in 1864 became a lieutenant of cavalry in the Prussian army. In 1865 he came with his parents to the United States and secured a position with the engineer corps of the army, and for two years was engaged in the survey of the Great Lakes. He had always been interested in entomology, and collected specimens while engaged in his engineering work. He became acquainted with the late C. V. Riley, who at that time was occupied in newspaper work in Chicago, and, when in 1868 Riley was appointed State Entomologist of Missouri, Lugger went with him as his assistant. During the years 1868 to 1875, when Riley established his great reputation as economic entomologist and published eight of the nine annual reports which brought him lasting fame, Lugger remained his quiet, unassuming, self-sacrificing and devoted helper. In 1875 he married Lina Krokmann and went to Baltimore, where he became the curator of the

Maryland Academy of Sciences and naturalist of the city parks. In 1885 he was appointed assistant in the Division of Entomology of the U. S. Department of Agriculture, remaining in Washington until 1888, when he was appointed entomologist to the State Agricultural Experiment Station of Minnesota, publishing his first bulletin in this new office July 3, 1888.

His first entomological experience in the State of Minnesota was one of great interest and importance, and his vigorous and intelligent action in the face of a great emergency fixed his standing as a most useful officer firmly in the minds of the Minnesota farmers. An enormous swarm of the Rocky Mountain locust or western migratory grasshopper had settled down in Ottertail County. By Lugger's advice and energetic field work, backed as he was by a public-spirited and intelligent governor (Hon. W. R. Merriam, now director of the U. S. Census) who personally guaranteed the funds necessary for the campaign, the hordes of destructive insects were annihilated and great damage was averted.

From that time to the time of his death, nearly thirteen years, Lugger's work was most active; his publications were frequent, and he gained the profound respect of his constituents and of the scientific men of the country. His bibliography, covering about thirty titles of record, comprises almost exclusively articles on economic entomology, but he was by no means a one-sided naturalist. He was a good botanist and published several papers concerning plant diseases, notably his article on the black rust or summer rust (Bulletin 64, Univ. Minn. Agric. Exp. Station).

Some years ago he began the publication of a series of large papers which when brought together would have formed an elaborate treatise on the entomology of Minnesota. The parts which had been published were an extensive paper on the parasites of man and domestic animals (Bul. 48, 1896, Minn. Agric. Exp. Sta., pp. 72–270, figs. 187, plates 16), the Orthoptera of Minnesota (Bul. 55, 1897, pp. 91–386, figs. 187), the Lepidoptera of Minnesota (Bul. 61, 1898, pp. 55–334, figs. 237, plates 24), the Coleoptera of Minnesota (Bul. 66, 1899, pp. 85–331, figs. 249, plates 6), and the Hemiptera of Minnesota (Bul. 69, 1900, pp. 1–259, figs. 200, plates 15). It is a great pity that Lugger did not live to complete this series, since the elaborate numbers were profusely illustrated and were prepared with great care and written in a most interesting style. At the time of his death he was preparing the part on Diptera, in which he intended possibly to include the Neuropteroids. It is greatly to be hoped that his manuscript was sufficiently advanced to permit its publication.

Aside from his scientific ability, Lugger was a man of admirable qualities. His wide information, his agreeable personality and his keen sense of humor made him one of the most delightful companions I have ever known. Many of his stories and humorous sayings are current among entomologists all over the United States, and his loss will be felt for many years to come. He leaves a widow and two children—a daughter, Mrs. Linnea Clarke, and a son, Humboldt Lugger, the latter now living in Kentucky.

L. O. HOWARD.

SCIENTIFIC BOOKS.

The Phytogeography of Nebraska. I. General Survey. 2d Ed. ROSCOE POUND and FREDK. E. CLEMENTS. Published by the Botanical Seminar, University of Nebraska, Lincoln, Neb. 1900. 8vo. Cloth. Pp. 442 and 4 maps.

To those who have not paid special attention to this branch of investigation this volume will prove to be both a revelation and an incentive to learn. It is a revision of the first edition, issued some three years ago, with additional material

acquired since that time, the larger part of the first edition having been destroyed by fire in the building of the publishers.

In its broadest conception the subject is happily defined as 'the study of vegetation,' or in other words, the study of the floral covering of any area in the aggregate. It deals with the plant groups rather than with individuals, and with the interrelations of species rather than with the species themselves, and discusses the reasons why certain plants have become established in certain areas, the effects of environment, etc.

The treatment of the subject begins with an historical review of the investigations which have been made in the flora of Nebraska, commencing with the expedition of Lewis and Clarke during the years 1803–1806, and continues through what may be called the era of exploration, to about 1870, up to which time the study of botany was merely incidental, in connection with general surveys and explorations. Botany as a distinct subject of investigation did not receive attention until 1871, and it was not until 1884 that it was prosecuted in earnest, under the direction of Dr. C. E. Bessey, who was elected to the then newly created chair of botany in the University of Nebraska. The botanical seminar of the University was organized, and for the first time a systematic investigation of the flora of the State was begun.

The preliminary work of cataloging the flora of the state was accomplished and then was commenced the study of the vegetation as a whole, in connection with topography, geology, meteorology, etc.

Four phytogeographical 'regions' are recognized, as follows:

I. Wooded-bluff and Meadow-land.
II. Prairie.
III. Sandhill.
IV. Foothill.

Regional limits, within a relatively small and artifically limited area such as the State of Nebraska, are primarily dependent upon physiography. Vegetation 'zones' and 'realms' are only applicable to more extended areas, with natural boundaries based on geographic or climatic conditions.

Following the system of Drude, the phytogeographic regions of Nebraska would all be included within the Middle North American Realm of the Northern Zone, and by a division of this realm into 'provinces' (Allegheny, Prairie, Rocky Mountain, Great Basin and California) the greater portion of the State would fall within the second of these, with a small strip along the eastern edge representing the first.

Lists of species peculiar to each region, those that are common to two of the regions, and those that are common to three or more of the regions, are given. The distribution of any species, or in other words the area over which it occurs, is of course a mere matter of more or less careful observation, but the abundance of a species can only be determined by careful investigation and calculation, the method of which is described, together with the formulæ adopted.

The terms employed are somewhat bewildering in their number and the fineness of their distinctions, and doubtless many who are not directly interested in the subject may become impatient at the necessity for mastering the differences between 'abundant,' 'frequent,' 'sub-frequent,' 'infrequent,' 'sparse,' 'rare,' 'solitary,' 'copious,' 'gregarious,' 'gregario-copious,' etc.

In the division of the plants into 'vegetation-forms' will be found another series of terms, popular and scientific, such as woody plants ('trees,' 'shrubs,' 'under-shrubs,' 'climbers and twiners'), half shrubs, herbs ('rosettes,' 'mats,' 'succulents,' 'sod-formers,' 'rootstock-plants,' etc.), water plants ('floating,' 'submerged' and 'amphibian'), saprophytes, parasites, mosses, fungi, algæ, etc., with discussion of habitat, foliage, protective devices, period of flowering, methods of dissemination, etc.

The factors concerned in the phenomena of phyto-geography are both physical and biological. They are connected with environment (topography, temperature, moisture, mechanical and chemical composition of the soil, etc.), and with the influence of animals, including man, as well as with the influence of plants upon each other, and each natural group of plants may be affected differently by the same factor or factors. In this connection each natural group is discussed in sequence.

The final part of the work deals with what is denominated 'plant formations,' and a plant formation is defined as 'a piece of the floral covering, the extent of which is determined by a characteristic correlation or association of vegetable organisms, *i. e.*, it is a stretch of land the limits of which are biological and not physiographical.' They may or may not, therefore, be coextensive with the regional distribution of the plants which compose them.

With respect to their origin they may be either primitive or recent. Primitive origin is necessarily more or less conjectural. It involves the study of the extinct flora of the region and the geologic changes which finally led up to the establishment of existing conditions. Recent formations may arise either from nascence or by modification. If by nascence they must originate upon areas previously destitute of any floral covering, while in the second case they are formed by the elaboration or modification of existing formations, often by the intrusion of foreign elements. Abandoned cultivated patches may represent the first, timber claims the second. Formations often disappear through the agency of fires, floods, mankind, etc., in which cases new formations may arise by nascence.

As an example of the latter is quoted the establishment of *Botrydium granulatum* or *Vaucheria sessilis*, with the cup fungi *Humaria* and *Scutellinia*, on muddy flats, formerly occupied by water plants, but subsequently exposed by the drying up of ponds or streams. A carpet-like layer may then supervene, composed of *Riccia glauca*, *Funaria hygrometrica*, etc., which in turn may be replaced by low-growing flowering plants, such as *Portulacca oleracea*, *Lepidium intermedium*, etc., and this in turn may yield to taller growing *Chenopodiums*, *Amaranths*, etc.

In the origination of formations by modification two sets of factors may be distinguished—natural and artificial. The first are either biological or physical, the second are due to the influence of man or other animals. An unusually wet season in the sandhill region or a dry one in the lowland will often modify the floral covering in a striking way, and modification through the agency of man is too obvious to require more than passing mention.

The various plant formations recognized are finally considered in detail and discussed under headings and sub-headings, physiographical and biological. For example, under the forest formations may be found the river-bluff formation, including (1) the red oak-hickory formation, (2) the bur oak-elm-walnut formation, etc.; under prairie formations, (1) prairie grass, (2) buffalo grass; under foothill formations, (1) under-shrub, (2) mat and rosette, (3) grass, etc., and many others.

The work as a whole is exceedingly valuable for the wealth of facts recorded, irrespective of any conclusions which may be deduced from them, and no one can fail to appreciate the immense amount of conscientious labor which it shows.

ARTHUR HOLLICK.

Synopsis of the Naiades, or Pearly Fresh-water Mussels. By C. T. SIMPSON. Proc. U. S. National Museum, XXII. 1900. Pp. 501–1044.

Some people think that the preparation of zoological catalogues and synopses is a low grade of work, which should be turned over to those who are not capable of doing anything better. Certainly one occasionally meets with examples of zoological bibliography bad enough to have been compiled by the most incompetent, but it is to be remarked that the authors of these works are often really skilled in anatomy or some other branch of the science. The fact is that the preparation of such a work as we have before us, with its orderly arrangement of innumerable references, requires not merely a high grade of intelligence, but a special kind of ability, which is none too common. We may therefore begin by thanking Mr. Simpson for a work which no other living man was equally competent to produce, and which will be invaluable to all students of the naiades. But to regard the work as merely a piece of good bibliography, would be extremely erroneous. Mr. Simpson has carefully studied a considerable majority of the species, and the arrangement of them is original with him. He has, by an examination of the soft anatomy, been able to show that the genus *Unio* of authors is in reality a heterogeneous mass of distinct genera, which

he duly describes. In all, 72 genera are recognized, of which 25 were first named by Mr. Simpson, while many others, credited to various authors, were first properly defined by the same writer. All this amounts to a revolution in naiadology, comparable with that produced by Pilsbry in the study of the Helicidæ.

Of interest to general biologists will be the map given showing the distribution of the naiades. In the Old World the regions of Sclater and Wallace are respected by the freshwater mussels, except that New Guinea goes with the Oriental region, as also do Japan, Corea and Manchuria. In America the neotropical region is valid for naiades, but North America is divided into three primary regions, the Atlantic, the Mississippi and the Pacific, but the last is considered a part of the Palearctic! In all about 1,117 species are recognized, many having long lists of synonyms. Concerning the innumerable so-called species described from France by the followers of Bourguignat, Mr. Simpson says: "Life is too short and valuable to be wasted in any attempt at deciphering such nonsense, and I have not even cumbered the pages of this work with a list of these new species." It is indeed unfortunate that the interesting character of the European fauna should be obscured by the treatment it has received at the hands of its students. The freshwater mollusca, in particular, exhibit a wonderful polymorphism, which in the highest degree merits the attention of the evolutionist; but when every varying phase is designated a species the result is mere chaos. When I lived in England, I knew of a number of ponds producing special forms of *Limnæa* (particularly *L. stagnalis*), which were so different that they could be recognized at a glance; one of the most distinct of these varieties abounded in a pond no bigger than a large rug, and was found nowhere else. The same sort of thing is true of the European naiades, and a careful comparative study of all the forms called species by the Bourguignat school, with an account of the several conditions under which they exist, would be an extremely valuable contribution to biology.

As is inevitable in so great a work, a few errors of nomenclature occur. The new genus *Dromus* will be considered by some too similar in name to *Dromius*, Bon., but I think it should be allowed to stand. The genus *Nodularia* Conrad, 1853, is preoccupied by *Nodularia* Oken, 1815. This will apparently oblige us to call the genus *Lanceolaria* Conrad, with *Lanceolaria grayana* (Lea) as the type, while the section of *L. douglasiæ* (Gray) can be called *Nodularidia* n.n. On p. 851, *Ptychorhynchus incertus* should be *P. murinus* (Heude), and on p. 897, *Spatha tristis* should be *S. rochebrunei* Jousseaume.

T. D. A. Cockerell.

East Las Vegas, N. M., May 12, 1901.

SCIENTIFIC JOURNALS AND ARTICLES.

The leading article of the *Botanical Gazette* for May is the 'Genetic Development of Forests of Northern Michigan, a study in Physiographic Ecology,' by H. N. Whitford. The factors that influence tree growth are divided into three groups—climatic, ecologic and historical. Favorable climatic factors make possible a forest formation; ecologic factors bring about the plant society condition; and the historical factors, by changing the physiographic features, change the plant societies. The life histories of five series of plant societies are discussed, *viz.*, sand, clay, rock, swamp and clearing societies. In four cases there is a gradual progression from xerophytic societies to a mesophytic forest. In the case of the swamp the progress is from hydrophytic societies to a mesophytic forest. The article is illustrated with eighteen half-tone reproductions of photographs. E. W. D. Holway contributes his third paper on 'Mexican Fungi,' in connection with Dr. Dietel, describing thirty-one new species of Uredineæ. Mr. G. M. Holferty gives the results of his study of the ovule and embryo of *Potamogeton natans*, clearing up a number of gaps in our knowledge of this primitive monocotyledonous type. The paper is illustrated by two excellent plates. Mr. Charles T. Druery, of London, writes upon 'Fern Variation in Great Britain,' and calls the attention of American students to the great scientific value of looking after fern 'sports.' Mr. D. G. Fairchild, agricultural explorer of the U. S. De-

partment of Agriculture, contributes his fourth 'Notes of Travels,' dealing with 'Coffee growing in Brazil and the giant Jequitibá trees.' The usual Book Reviews, Minor Notices, Notes for Students, Open Letters, and News Items close the number.

Terrestrial Magnetism and Atmospheric Electricity for May contains the following articles:

'Summary of the Results of Recent Investigations in Atmospheric Electricity' (Concluded): F. EXNER.

'The Physical Decomposition of the Earth's Permanent Magnetic Field—No II.'; 'The Composition and Characteristics of the Uniform Magnetic Field': L. A. BAUER.

'Résumé of Magnetic Work at Bombay Observatory in 1897.'

'The Magnetic Work of the Norwegian North Polar Expedition, 1893–1896': D. L. HAZARD.

'Summary of Results of Recent Comparisons of Magnetic Instruments': L. A. BAUER.

'Schuster's Researches on the Solar Rotation and the Lunar Period in the Earth's Magnetism.'

'Biographical Sketch of William Ellis' (with portrait).

THE number of *Popular Astronomy* for the months of June and July has for its frontispiece the orbit of the new comet discovered by Halls, of Cape Colony; the elements and ephemeris as computed by Dr. Kreutz accompanies a brief article upon the comet. Among the other short articles is one by E. C. Pickering on the 'Variability of Light of Eros.' From the *British Journal of Photography* there is reprinted an article on the scientific value of photography for astronomical investigations. The recent eclipse is still too near us to have obtained full knowledge of the results, but a discussion of 'What Eclipses Teach Us,' comes from the pen of David P. Todd, who went out with the Amherst party to Sumatra. Miss Mary Clark Traylor gives an explanation of the method of computing an ephemeris of a planet or comet, of interest to the amateur astronomer. Spectroscopic notes, planet notes and the usual planet tables are included in the number.

THE Museums Association of Great Britain will commence in July the publication of a monthly journal devoted to the interests of museums in general. Besides the proceedings of the Museums Association it will contain current news of museums and art galleries, illustrated descriptive articles, reports of museums, reviews of books and brief notes. Mr. F. A. Lucas, of the U. S. National Museum, will act as the American correspondent of the journal, and he will be glad to receive any articles, no matter how brief, pertaining to the work of museums in the United States, or they may be sent directly to the editor, Mr. E. Howarth, of the Sheffield Museum, England.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 536th regular meeting was held May 11, 1901. The special order of business was to consider the question of incorporating the Society under the general laws of the United States for the District of Columbia. After discussion it was unanimously

Resolved, That the Philosophical Society adopt the recommendation of the General Committee to incorporate the Philosophical Society of Washington, and that the carrying into effect of the foregoing resolution be entrusted to the General Committee.

The 537th meeting was held May 25, 1901. The Chairman, V. P. Rathbun, stated that pursuant to the instructions of the Society at the last meeting the General Committee had filed Articles of Incorporation on May 20, 1901, said Articles being signed by three of the founders of the Society and 23 past presidents and other officers of the Society. He also stated that at a meeting of the incorporators just held all the members of the Society had been elected to the incorporated society.

A code of by-laws was adopted, and the former officers were elected to corresponding positions in the new Society.

President Walcott then took the chair. In response to a question, and after discussion, he ruled that the organization was to be continuous, and that the present meeting did not begin a new series.

The first regular paper was by Dr. G. M. Sternberg on the 'Transmission of Yellow Fever by Mosquitoes.' (This paper will appear in *The Popular Science Monthly*.)

Mr. J. W. Froley then described some 'Appliances for describing Oval and Circular Arcs of very large radius.' The principal one depended on the fact that a uniform elastic bar, bent by equal oppositely directed forces takes the form of a circular arc. The presentation was too mathematical to be condensed here.

The Society then adjourned till October.

CHARLES K. WEAD,
Secretary.

TORREY BOTANICAL CLUB.

AT the meeting of April 9, 1901, the scientific program consisted of a 'Report on a Recent Visit to the Royal Gardens at Kew, England,' by Mr. George V. Nash. Mr. Nash was absent about six weeks, nearly the entire time on the other side being spent at the Royal Gardens, Kew, securing specimens of living plants for the New York Botanical Garden. The collections were carefully inspected under the guidance of the officers of the institution, and such duplicate material picked out as was desired. In this way much valuable material was secured, both for the outside and conservatory collections. Many of these were procurable only at a botanical garden, and a number of them were not obtainable elsewhere than at Kew. Of the large number of plants selected, over 1,000 species have already been received and incorporated in our collections. These include about 550 species of herbaceous plants, 350 shrubs and trees, and 150 succulents. The remainder of the material will follow as fast as the authorities at Kew can select it.

Dr. Britton remarked that the favor accorded by Sir William Dyer in permitting Mr. Nash to select duplicates of living plants from the rich collections at Kew would be most gratefully appreciated not alone by the managers and members of the New York Botanical Garden, but by all American botanists.

Dr. Britton presented a communication on a tree new to the American continent, a white birch from the Alaska region, collected by Mr. R. S. Williams and Mr. Tarleton and represented in the U. S. National Herbarium also by two specimens collected by Miss E. Taylor.

At the meeting of April 24th a paper by Professor Francis E. Lloyd, entitled, 'The Genus *Lycopodium*: A Criticism,' in the absence of the author, was read by the secretary pro tem. This was a review and criticism of the treatment of the genus *Lycopodium* by Pritzel in the recently published part of Engler and Prantl's 'Die natürlichen Pflanzenfamilien' dealing with the Lycopodiaceae. The paper will be published in full in an early number of *Torreya*.

Professor Underwood remarked on segregations in the *Selaginella rupestris* group, stating that Dr. Hieronymus, of Berlin, had recently recognized twenty-seven species in this group, some of them American, outside of those recently proposed in this country.

MARSHALL A. HOWE,
Secretary pro tem.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of May 20, twenty-six persons present, Professor George Lefevre presented a comprehensive address on the advance made in the science of zoology during the nineteenth century.

Professor F. E. Nipher presented a paper determining the specific heat of a nebula, in process of gravitational contraction. It is found to be equal to the constant for the gas, provided by the mechanical equivalent of heat. This is also equal to the difference between the specific heats, at constant pressure and at constant volume. The relation between pressure and volume of the gaseous mass during contraction is determined in terms of the fundamental constants, the gravitation constant, the constant of the gas and the mass of the contracting nebula. In the same way, the relation of pressure to temperature and of volume to temperature are determined. It is a matter of profound significance that a cosmical gaseous mass can apparently pull itself together, and at the same time become warmer, as it might if compressed by some external force. It raises the question whether the mass does really contract itself when it gravitates into a smaller volume, or is gravitation, after all, a force acting from without and upon the two bodies which seem to attract each other?

One person was elected to active membership.

WILLIAM TRELEASE,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

REMARKABLE DISCOVERIES.

IN *McClure's Magazine* for June there appears an article, entitled 'Geology and the Deluge: Remarkable Geological Discoveries in Central Asia and Southern Russia, showing that the Noachian Flood is a Scientific Possibility,' by Dr. Frederick G. Wright, Professor of the Harmony of Science and Revelation in Oberlin College.

The first of these 'discoveries' is entitled 'No Glacial Period in Asia.' It is set forth in the following words:

"For many years I have been collecting facts concerning the glacial period in North America and Europe, and in 1900 I went to Siberia to determine conditions in that country in the same period. As Asia, like North America, stretches toward the North Pole and faces a great sea on the east, I naturally expected to find there evidences of a glacial period similar to that in this country. But, contrary to all my expectations, I found no sign in Central Asia and Southern Siberia of glacial work. On the contrary, the geological conditions I found were such as are only to be explained by an extensive submergence of the region where the Scriptures and tradition locate the Flood which destroyed the whole human race, excepting Noah and his family. The evidences of such a deluge are not one, but several, and extend from Mongolia to the western borders of Russia."

The state of previous knowledge may be inferred from the following quotations from well-known works, to which others might be added:

"It is a familiar fact that there are no traces of glaciation in Northern Asia, but on the contrary there is the most complete and consistent evidence that no such traces are to be found either on the flat tundras or on the higher ground. Murchison long ago showed that there are no marks of ancient glaciation on the Urals, which it must be remembered rise in places to a height of 1,525 metres, and are in many places covered with snow for eight months in the year. Repeated visitors have tried in vain to find old glacial traces in the Altai Mountains. Lastly, traveller after traveller across Northern Asia speaks of the absence of all boulders, rounded rocks, etc., in Siberia from one end to the other." ['The Glacial Nightmare and the Flood,' by Sir Henry Howorth, Vol. I., pp. 510, 511, 1893.]

"These [certain mountainous and plateau tracts], as far as I can learn, are the only regions in Asia which have yielded certain traces of glaciation. (See Plate XIV.)" [The plate shows no general glaciation in Siberia or Central Asia.] ('The Great Ice Age,' by James Geikie, third edition, p. 697, 1894.)

"East of the Urals in Northern Asia there is no evidence of moving ice upon the land during the Glacial period." ('Man and the Glacial Period,' by G. Frederick Wright, p. 190, 1892.)

The second 'discovery' relates to the general prevalence of loess in the region named. This is set forth as follows:

"*Evidences of a great sea around Mt. Ararat.*—On the contrary, throughout this entire region we were confronted with the evidence of a great subsidence of the land which had taken place in recent geological time, and which, in date, would correspond roughly with that of the glacial period in North America. For several hundred miles, while driving through the region south of Lake Balkash and the Aral Sea, we were evidently upon a terrace of the fine loam which is called loess, about 2,500 feet above sea-level. Indeed, at different elevations this loess extends continuously in a broad shelf along the base of the mountains, from the Irtish River to the Caspian Sea, and is found in extensive areas over various portions of the Caucasus and Northern Persia around the base of Mount Ararat; while the so-called 'black earth' of Southern Russia is a deposit of the same material, and probably of the same age, 100 or more feet in thickness. The distribution of this loess is the key to the whole situation" (p. 135). [The map accompanying the article 'showing the country through which Dr. Wright traveled, and where he found evidences, not of glaciers, but of a flood,' and on which the itinerary is marked, indicates that Dr. Wright did not visit Mt. Ararat or the Biblical lands.]

The degree of originality of this 'discovery' of the distribution of the loess may be inferred

from the following quotation from Geikie's 'Ice Age' in the chapter on Asia:

"Immense sheets and terraces of loess fringe the alpine lands and sweep outwards upon the low grounds of Turkestan and Siberia, but do not seem to go much farther north than 54° N. L. These, as Kropotkin shows, present the same character as the similar accumulations of Europe, and have yielded remains of mammoth, rhinoceros, etc., and land shells. In Northern China the same accumulation is developed on a yet grander scale—covering enormous areas, and occurring at all altitudes from a few feet to upwards of 8,000 feet above the sea. The distribution of the Asiatic loess, its general character, and the nature of its organic remains hardly allow us to doubt that it has been formed under the same conditions as the similar deposits in Europe. Its materials, we may believe, are largely of fluvio-glacial origin, and represent in great measure the flood-loams swept down from the mountains and plateaus when these supported extensive snow fields and glaciers. But, as Baron Richthofen in his great work on China has demonstrated, the loess, as we now see it, owes its structure and heaping-up to the action of the wind, and is even now forming and accumulating in many regions of Asia. It is, in short, a true steppe-formation." (Geikie's 'Great Ice Age,' p. 699.)

In discussing the origin of the loess, Dr. Wright omits all direct reference to the familiar interpretation sketched by Geikie and held by many geologists on both continents, and thus adroitly creates the impression that the question of its deposition lies solely between the work of the wind and the work of the sea. The following extract embraces the essential part of the statement:

"Twenty-five or thirty years ago Baron Richthofen endeavored to make out that the loess was a wind deposit; and certainly he found much in Northeastern China to support this theory. Upon returning from our trip to the Mongolian frontier, we were inclined to accept it, for we had seen and experienced, in the dust-storms encountered, enough to make us attribute almost anything to the power of wind. For a whole day we once rode in a cloud of dust so dense that it was impossible to see objects twenty feet away; while everywhere in the mountain valleys we saw instances where this loess had drifted into protected places, as snow does in winter. But there were constantly appearing other things which were difficult to explain by the action of wind. For example, the loess was occasionally spread out, even at high levels, in broad, lakelike basins, as if deposited by water. Also the material now most blown about by the wind is coarse sand, which is piled up in dunes quite unlike the ordinary loess deposits. In one instance we found high walls of a large Chinese city completely buried on one side by a wind deposit; but this was coarse sand, and not loess. In many cases, also, we found long lines of gravel and pebbles interstratified with loess. Thus the difficulties of explaining everything by wind so increased that they became well-nigh insuperable.

"But, on coming around to the northwestern side of the great Asiatic plateau, in Turkestan, which is almost the exact center of the continent, the wind hypothesis became entirely incredible, and the evidence accumulated that the land had lately been depressed to such an extent that the water of the ocean reached the base of the bordering mountains, rising to a height, certainly, of about 3,000 feet; for, at this level, south and southwest of Lake Balkash, we found the loess spread out in such an extensive terrace that the wind would be entirely incompetent to produce the results. * *

"In confirmation of this theory of a recent extensive depression of Central Asia, a number of other most interesting facts present themselves, prominent among which are those concerning Lake Baikal. * * * A most curious fact, long known to scientific men, is that this lake is occupied by a species of seal almost identical with those found in the Arctic Ocean. The same species with slight variations are also found in the Caspian Sea, but not anywhere else along the 3,000 or 4,000 miles which separate these bodies of water. The most probable explanation of this fact, and the one usually accepted by scientific men, is, that these species of seal were thus widely distributed during a continental subsidence in which all the waters of the Arctic Ocean

covered all of Northwestern Siberia, and extended up to the base of the great Asiatic plateau which we followed for such a long distance on elevated shore lines in Turkestan. When this depressed area emerged from the sea, it left the seal isolated in the two great bodies of water which still remain on its former margin. So lately has this taken place, that there has not been time for any great changes to be effected in the characteristics of these animals" (p. 136).

Certain high-level deposits at Trebizond and Dariel Pass are cited as the work of the sea and as evidence of subsidence of the land, but no fossils are mentioned (p. 137).

Singularly enough, the comparative *freshness* of the waters of the Caspian and Aral seas made the basis for the inference that "this region has lately emerged from below sea level and, in consequence, rapidly passed through climatic changes which have transformed it from a recently well-watered region to one that is now a desert" (p. 137).

This is the entire evidence upon which the marine origin of the loess is postulated. The direct evidence of the fossil content of the loess is ignored. The public are not even informed of the existence of this class of evidence, nor of such widely current deductions from it as those voiced by Dr. James Geikie in the paragraph previously quoted and by Sir Archibald Geikie in the following extract from his well-known 'Text-Book':

"Though on the whole not rich in fossils, the loess has yielded a peculiar fauna, which singularly confirms Richthofen's view that the deposit was a subaerial one. In the first place, the shells found in it are almost without exception of terrestrial species. * * * It is worthy of note that *Helices* and *Succineas* abound at present in the steppe regions of central Asia, and that many of the species of loess mollusks are now living in east Russia, southwest Siberia, and on the prairies of the Little Missouri in North America.

"From various parts of the European loess, Dr. Nehring has described a remarkable assemblage of animals, which included a jerboa (*Alactaga jaculus*), marmots (*Spermophilus*, several species), *Arctomys bobac*, tailless hare (*Lagomys pusillus*), numerous species of *Arvicola*, *Cricetus frumentarius*, *C. phœus*, porcupine (*Hystrix hirsutirostris*), wild horses, and antelopes (*Antilope saiga*). This fauna, excepting some extinct or extirpated species, is identical with that which now lives in the southeast European and southwest Siberian steppes. Besides these distinctively steppe animals the loess contains numerous remains of the mammoth and woolly rhinoceros, likewise bones of the musk-sheep, hare, wolf, stoat, etc. It has also yielded flint implements of Palæolithic types. The bones of man himself were claimed many years ago by Ami Boué to have been found in the loess, and his opinion has been in some measure strengthened by more recent observations." ('Text-Book of Geology,' by Archibald Geikie, pp. 1059, 1060.)

The readers of *McClure's Magazine* are not invited to consider the overwhelming force of this class of evidence; nor are they frankly told of the absence of marine fossils from the loess; nor are they informed that the association of Palæolithic implements with the loess is familiar text-book knowledge; but in lieu of such prosy science, they are inspired by the following eloquent climax:

"The crowning point of interest is reached in the discovery by Professor Armashevsky at Kief of flint implements and burnt stones in connection with the bones of extinct animals fifty-seven feet below the undisturbed surface of this soil. The discovery was made in the bluff of loess bordering the river Dnieper, whose general surface is 633 feet above the sea and 340 feet above the present stream, and totally unconnected with any deposits that may have been made by it. In this discovery we have the link connecting the recent geological changes in the East with those in the West. The flint implements of glacial man found in France, England, and the United States indicate the same stage of culture as that attained by the men who were overwhelmed in the great subsidence of Central Asia and Southeastern Russia, and of the region about the base of Mt. Ararat" (p. 138).

This remarkable article closes with 'The Relation of These Discoveries to the Bible Story of the Deluge,' and 'Harmony of Biblical Story and the Geological Facts.'

"* * * What the recent discoveries have shown is, that during, and subsequent to, the glacial period, and since the advent of man, there has existed such an instability of the earth's crust that the present cannot be made a measure of the past. Man has certainly witnessed catastrophes by flood which are quite analogous to the one described in Genesis. But it is important, in conclusion, to obtain correct ideas of what we are required by the narrative to believe. * * *

"1. The biblical account of the flood does not imply, as many seem to assume, that the waters of the earth increased to such a degree that it swelled the circumference of the globe to the extent of the tops of the highest mountains. * * * (p. 138.)

"2. Nor is it necessary, except for the purpose of effecting the destruction of the human race, to suppose that the flood was, in the strict sense of the word, universal. We may well believe that the end in view, namely, the destruction of the human race, with the exception of Noah and his family, was accomplished without the destruction of all forms of animal life whose existence was unconnected with the general moral reasons for the flood. * * * The objects of the flood were all satisfied if the destruction of the human race was fully accomplished, so that history could make a new start with a selected family. * * * (p. 138.)

"Some time during the prevalence of glacial ice over Northern America and Northwestern Europe, man came into existence in Central Asia, where the climate was still congenial. From this point he spread as far west as the Atlantic seaboard in Europe, and eastward to the Pacific Coast, whence he succeeded in reaching, by way of the Bering Sea and Alaska, the western coast of North America, and thence migrated to the Atlantic Coast, where his remains are found in the glacial gravels of Trenton, New Jersey. But the extreme and rapid changes incident to the closing stages of the glacial period naturally, and very likely, exterminated man in company with many of the animals accompanying him both in America and in Europe. The destruction of many of the species of animals accompanying man at the close of the glacial period is a well-known fact. It also seems probable, from scientific evidence, that man shared largely in the destruction. There is everywhere a sharp line of distinction between Palæolithic and Neolithic man, *i. e.*, between the men who were limited to the use of flaked or rough stone implements and those who used smoothed stone implements. It is Palæolithic implements only which are found in the glacial gravels of America and Northwestern Europe, and beneath the loess at Kief and at three or four other localities in Southern Russia. The Palæolithic man of science may well be the antedeluvian man of Genesis" (p. 139).

From this it appears, a little darkly and vaguely, that the public are to understand from these 'recent' and 'remarkable discoveries' that Paleolithic man, scattered over Asia, Europe and America (and Africa?), was destroyed by the flood, where there was a flood, and by 'the extreme and rapid changes incident to the closing stages of the glacial period,' and that this gave rise to the 'sharp line of distinction between Paleolithic and Neolithic man,' and hence, by implication, that Neolithic man was the descendant of Noah and that the line of cultural evolution was from ark-building to 'smoothed stone implements.'

One is led to wonder how far respect for the Scriptures is fostered by 'remarkable discoveries' of this sort and by the much-trumpeted stage-play that preceded and accompanied them. * * *

THE MONGOOSE IN JAMAICA.

It seems to be almost impossible for writers of text-books to give a correct account of the mongoose in the island of Jamaica, and its effect upon the native fauna. In *Nature*, February 7, 1901, I took occasion to point out a peculiar error in the account of the animal in an excellent text-book of zoology; to-day I open Mr. J. W. Redway's *Elementary Physical Geography* (1900) and read that the mongoose 'did not lessen the number of cane-rats,' but 'exterminated one or two species of ground-bird.' As in the former note just mentioned, I must beg those who wish to discuss this subject to read Dr. J. E. Duerden's article in *Journal of the Institute of Jamaica*, July, 1896, p. 288.

Here the facts actually known are duly set forth, and among other things it is shown that the rats were destroyed in great numbers, while it seems doubtful whether the 'ground-birds' were actually exterminated in any instance.

T. D. A. COCKERELL.

EAST LAS VEGAS, N. M.,
May 16, 1901.

AN EARTHWORK DISCOVERED IN MICHIGAN.

MR. G. N. HAUPTMAN, of Saginaw, Michigan, in a letter dated May, 1901, reports that 'there is on section 34, T. 21, N., R. 1 E., Ogemaw county, Mich., an earthwork [of horse-shoe shape]. The trench * * * is three feet' deep, and in it stand forest trees.

If any notice of this has ever been printed I should be glad to receive references to the same. I believe no note of this earthwork has previously been made, although four earthworks in the same county are well known and are recorded in the literature of archeology.

HARLAN I. SMITH.

PHYSIOLOGY IN THE SCHOOLS.

TO THE EDITOR OF SCIENCE: The writer has a 'horrible suspicion' that T. Hough imputes the physiological questions, to which he demurs, to him. He did not propound them. The high-school questions were taken from the text-book which the pupils had used, and if the text was legitimate, the questions were.

It is the writer's conviction that public school teachers are not generally qualified to teach physiology; that physiology proper is too abstruse for the grammar grades; and that the teacher in every grade should be expected to have a better knowledge of his subject than can be obtained from the elementary text placed in the hands of his pupils. Finally he may venture to express his fear that a little elementary knowledge of the reasons for the non-increase in stature of the human skeleton throughout life might not be amiss to his learned critic even.

S. W. WILLISTON.

SHORTER ARTICLES.

WHAT IS LIFE?

SOME thoughts, started by reading an article with the above title in *Nature*, Vol. 57, p. 138, 1898, by Horace Brown, and jotted down at that time, but laid aside, I have thought might perhaps interest the readers of SCIENCE, especially as the subject continues to be agitated.*

Heretofore in cases of dormant life, as in seeds kept for years, perhaps for centuries, or in dessicated infusoria, etc., in which under favorable conditions active life is revived, it has been supposed that very slow metabolic changes still go on during the state of dormancy—life is supposed to be feeble, but not extinct. The same was supposed to be the case in seeds or bacteria exposed to intense cold of — 180° to — 200° C. by Pictet or even — 250° by Dewar.

But it is now proved that at this temperature chemical affinity is destroyed and all chemical changes arrested, and therefore the chemical changes characteristic of life—metabolism—also must cease. But with the return of heat they revive. Therefore, in this case, life seems to spring spontaneously from dead matter. Must we then revive the old doctrine of spontaneous generation? If not we must change or greatly modify our conceptions of life.

From such experiments it is evident that, although life is, indeed, a distinct *form of energy*, yet its nearest alliance is with chemism. For as chemism is completely destroyed by extreme cold and again revived by heat, so life may be completely arrested by cold and again revived by heat—*if the molecular structure characteristic of living protoplasm* (whatever that may be) *remains unchanged.*

What then is the necessary condition of life—or, to put it clearly, what is the difference between *dead* protoplasm and *living* protoplasm, or rather protoplasm *capable of life?* Evidently it is not a difference in chemical composition, for no change in this regard takes place in the act of death. It is, I suppose, a difference in *molecular arrangement*—a difference in *allotropic condition.* As the necessary condition of chemical properties is a certain equivalent composition: so the necessary condition of vital properties is, in addition, a certain molecular constitution. But as equivalent composition may

Nature, Vol. 61, p. 67, 1899; Vol. 63, p. 420, 1901. *Revue Scientifique*, Vol. 15, p. 201, 1901, and SCIENCE, Vol. 12, p. 774, 1900.

remain, even though chemical activity be absent, so also the peculiar molecular constitution, characteristic of life may remain even though life—*i. e.*, active life—be absent. As chemism may be completely destroyed by cold and revived by heat, if the necessary condition, viz., a certain equivalent composition, remains: so life may be completely destroyed by cold, and again revived by heat if so be the necessary condition—a certain molecular constitution remains.

Again, Mr. Brown, in the article referred to, says that Spencer's definition of life, viz., 'a continuous adjustment of internal to external conditions' must be revised, since it applies only to *active* life and not to suspended life. I think not. Life in the true sense, *i. e.*, *actual* life must be active — the essential nature of life, as of all energy, is *activity*; but there is a necessary underlying condition, *i. e.*, a peculiar molecular constitution, which may be called *potential life*. As equivalent composition is potential chemism, which may under certain conditions become actual chemism, so a peculiar molecular constitution of protoplasm is potential life, which may under certain conditions become actual life. *Death* is not merely an *extinction* of life, *i. e.*, actual life, but also the *destruction* of the necessary condition of life, *i. e.*, the characteristic molecular structure of protoplasm. Extinction of life, therefore, is not necessarily *death*. There are therefore three conditions of protoplasm, viz.: (1) *living*, a condition in which life is actual; (2) *potentially living*, in which the necessary molecular constitution or vital constitution is present; and (3) *dead*, in which the vital constitution also is wanting.*

Joseph Le Conte.

Berkeley, Cal., May 24, 1901.

A 'SAND-BOW'—AN UNUSUAL OPTICAL PHENOMENON.

The following description, based on personal observation, is presented without discussion of the optical principles involved.

On the evening of May 16, the writer was crossing the main ridge of Antelope Island—the largest land body within the area of the Great Salt Lake. As he began the descent on the eastern slope, there appeared between the island and the mainland what seemed at first glance to be segment of a brilliant rainbow of unusual width. It was evident, however, that no rain was falling in that direction. Clouds were gathering in the south and west, but the sun was yet unobscured. A wind setting toward the mainland had lifted from the dry flats large quantities of the 'oolitic sand,' with which the lake bottom and the recently dried patches on this side of the island are covered to a depth varying from a few inches to several feet. This so-called 'sand' consists of calcareous spherules, fairly uniform in size between the limits of No. 8 and No. 10 shot. The oolitic bodies are polished and exhibit a pearly luster.

It would seem that the outer spherical surfaces reflected the light in such a manner as to produce the bow. The colored column appeared almost to touch the lake bed, and its ends subtended with the observer an angle of about 40°. The prismatic colors were distinct, the red being outside, *i. e.*, away from the sun. In apparent width the column was fully double that of the ordinary rainbow. A fainter secondary bow was plainly visible beyond the primary, with the colors in reverse order. The phenomenon was so brilliant as to attract the attention of all members of the party, and it remained visible for over five minutes, then, as the sun sank lower, it rapidly died away.

The production of a color bow by reflection from the outer surfaces of opaque spherules is a new phenomenon to the writer. It is inexplicable on the principle of refraction and total reflection from the interior of transparent spheroids, according to which the rainbow is generally explained.

If phenomena similar or analogous to the foregoing have been observed, reports of the same would doubtless be of instructive interest.

James E. Talmage.

University of Utah,
Salt Lake City, May 20, 1901.

* Similar views on the molecular constitution of living protoplasms were brought out by me, in January, 1892 in a lecture before the Philosophical Society of Washington. *Bulletin*, Vol. XII., p. 29, 1892.

NOTES ON INORGANIC CHEMISTRY.

PLATINUM IN ANTIQUITY.

PROFESSOR BERTHELOT reports in a recent number of the *Comptes Rendus* that on a metallic box from Egypt, covered with inscriptions, he found a portion of one of the characters made of platinum. The mass was too small for a complete analysis, but from its behavior toward aqua regia, it appeared to be native platinum. The date of the box was about 700 B. C. From two standpoints this discovery is of more than passing interest. It has been a much disputed question whether platinum was known to the ancients. Passages from the classics have been quoted which appear to some to be references to platinum, but this application is in every case very doubtful. A much stronger argument against the probability of platinum being known more than a few centuries ago, is, that until this discovery of Berthelot's, no trace of the metal has been found in any ancient remains. Had platinum been known, it is hardly conceivable that specimens of it should fail to be found somewhere among the multitudinous remains of antiquity. This present discovery really emphasizes the argument, for it would seem from the description given by Berthelot that this specimen of platinum was used by the workman unwittingly, resembling as it does some of the pale gold of Egypt. A second interesting point is that if Berthelot's conjecture be true that this is native platinum, obtained from the alluvial deposits of Nubia or the upper regions of the Nile valley, it is the first recorded occurrence of platinum in Africa, with the single exception of an observation of Aimé, in 1838, that some of the galena from Algeria contains a trace of platinum.

LEAD IN POTTERY GLAZES.

THERE has been much discussion in England the last few years regarding the use of lead in pottery glazes, with reference both to the health of the potters and to the dangers attending the use of lead-glazed vessels in culinary operations.

In continental potteries a lead glaze is in frequent use which seems to be far more resistant to the action of solvents than those in use in England. The subject was recently brought before the Chemical Society by Professor T. E. Thorpe and C. Simmonds, and an abstract of their work and of the discussion of their paper is found in the *Proceedings* of the Society. Examining a large number of glazes, they find that many of them are attacked by dilute acids, comparable with the acids found in the human system, such as the hydrochloric acid of the gastric juice. They find that the resistance depends upon the ratio of base to silica in the glaze. Provided that the ratio falls within certain limits, the amount of lead extracted under the prescribed conditions is always small, though the actual quantity of lead in the glaze may vary from zero to 50 or even 55 per cent. The amount of the other bases, such as alumina, lime and alkalies, may vary considerably and the silica may be replaced to some extent by other acids, as boric acid. It is to be hoped that American potters, as well as the English, may profit by these investigations, which after all only serve to bring out what has long been in practice in the potteries of Germany.

COSMIC DIFFUSION OF VANADIUM.

IN 1897 Hasselberg called attention to the occurrence of vanadium in many specimens of rutile, as had indeed been noticed by Sainte-Claire Deville as early as 1859. Hasselberg has now turned his attention to the examination of meteorites, and finds the presence of vanadium in all those examined of the stony type, while in metallic meteorites it is absent, save in a single specimen in which a very small quantity was found. He has gone over the work of Lockyer on the meteoric iron from Nejed and Obernkirchen, and finds that his observation that vanadium is present in these irons is erroneous. From these investigations he deduces the conclusion that a different origin is indicated for stony and for metallic meteorites.

J. L. H.

CURRENT NOTES ON METEOROLOGY.

ANNALS OF THE MONT BLANC OBSERVATORY.

VOL. IV. of the *Annales de l'Observatoire météorologique, physique et glaciaire du Mont Blanc (altitude 4,358 m.), publiées sous la Direction de J. Vallot*, contains several interesting

papers. A study, entitled 'Influence de la Pression Barométrique sur l'Action chimique de la Lumière directe du Soleil,' by Dr. M. Andresen, deals briefly with the work of Bunsen and Roscoe, and other investigators, and presents results obtained by the author at the Mont Blanc Observatory. A short paper by M. and Mme. Vallot deals with 'Expériences sur la Vitesse de la Circulation de l'Eau dans les Torrents et sous les Glaciers.' The most important contribution is one by M. Vallot, entitled 'Expériences sur la Marche et les Variations de la Mer de Glace.' This is an elaborate study, setting forth the results of observations made by the author on the Mer de Glace during the nine years 1891–1899. The observations included variations in level, variations in velocity, and variations in velocity in relation to variations in level. The paper is illustrated by means of a series of 61 plates, published in Vol. V. of the *Annales*, and deserves attention on the part of all who are interested in glacial problems. These two volumes are further evidence that M. Vallot's Observatory is doing effective scientific work.

THE MOON AND THE WEATHER.

A new journal, *Climat*, printed in four languages under the editorship of M. Demschinsky, of Torbino, Russia, and devoted to the publication of articles on the relation of the moon and meteorological phenomena, has recently been widely advertised. So far, three numbers of this magazine have been received. M. Demschinsky published, in Nos. 1 and 2 of *Climat*, a series of curves showing the probable course of the barometer and thermometer during the month of April at a large number of stations. The only comparison of the predictions with the facts of observed weather conditions that has thus far been given publicity is discussed by Dr. H. R. Mill, in *Symons's Monthly Meteorological Magazine* for May. Dr. Mill has made a careful comparison of the predicted conditions and of the actual weather observed in the cases of Aberdeen and of Valencia. The conclusion reached is, as might have been expected, that 'practically the forecasts as a whole appear to be valueless,' so far as these two stations are concerned.

NOTES.

In the *National Geographic Magazine* for May an article by Gannett, on 'The General Geography of Alaska' (pp. 180-196), gives a good general account of the climate of that territory. This article forms one of the chapters of the volume dealing with the Harriman Expedition. The writer is inclined to believe "that if any part of Alaska can become of agricultural importance it is the interior rather than the Pacific coast. But it is doubtful whether even this region will admit of profitable farming. * * * However, as the higher rate of freight to the interior will have the effect of a protective tariff on home products, it may be possible to raise grain and vegetables at a profit under conditions which would be prohibitory on the coast."

The *Meteorological Observations for 1900*, as contained in the 13th Annual Report of the Colorado Agricultural Experiment Station, at Fort Collins, Colo., show that the mean annual evaporation at that station is 41.16 inches (10 years). This is the amount evaporated from a water surface in a tank 3 x 3 x 3 feet, flush with the ground.

Part VII. of the *Report of the Chief of the Weather Bureau for 1899–1900* contains the 'Meteorological Observations of the Second Wellman Expedition,' by Evelyn B. Baldwin, the leader of the present Baldwin-Ziegler Expedition.

R. DeC. Ward.

SCIENTIFIC POSITIONS UNDER THE GOVERNMENT.

The U. S. Civil Service Commission announces that it is desired to establish an eligible register for the position of laboratory assistant in physics, National Bureau of Standards, Treasury Department. It will not be necessary for applicants to appear at any place for examination. The examination will consist of the following subjects:

Education and training	30
Original investigations	30
Experience	20
Thesis	20
Total	100

From the eligibles resulting from this examination it is expected that certification will

be made to two positions as laboratory assistant in physics, National Bureau of Standards, Treasury Department, one at a salary of $1,200 and the other at a salary of $1,400 per annum.

On the same day an examination, which also will not require attendance, will be held for two assistant agrostologists in the U. S. Department of Agriculture, with salaries respectively of $1,600 and $1,400 per annum. The Department states that the positions for which this examination is held require thorough training and practical experience in subjects pertaining to grasses and forage plants and animal foods, and the management of grass lands and forage crops in the field. The subjects and weights are:

Training and experience with special reference to:	
(*a*) Theory and practice in agriculture	25
(*b*) Teaching or scientific research	10
(*c*) Publications and editorial work	15
	50
Thesis	30
Plan (to be devised by the applicant) for experiments to solve any forage problem	20
Total	100

On the same day there will, further, be an examination, not requiring attendance, for the position of scientific aid with a knowledge of statistics in the Department of Agriculture.

This examination will consist of the following subjects:

College course (with bachelor's degree) or its equivalent	40
Post-graduate work and special qualifications	30
Thesis or other literature	30
	100

Applications will not be received from other than graduates of colleges receiving benefits from grants of land or money from the United States, unless it is shown that the applicants have pursued courses of instruction having an economic bearing which will qualifiy them for the work of the Department of Agriculture. Applicants must show the scope of the studies pursued and the length of time devoted to them, the standing in such studies, especially with regard to the subject of statistics, and the special qualifications which they have for work upon this subject. They must also submit a thesis upon the subjects of statistics, or in lieu thereof such other literature on the subject as may have been published over their own signature. The salary of the position is $40 per month and no person will be permitted to serve as a scientific aid for more than two years. Scientific aids who pass in an open competitive supplementary examination in some technical or scientific subject or subjects which may be held will be eligible to certification from such supplementary register to higher positions within the classified service, regardless of their services as scientific aids.

THE AMERICAN ASSOCIATION.

SECTION A. MATHEMATICS AND ASTRONOMY.

THE officers of the section, Professor James McMahon, chairman, and Professor George A. Miller, secretary, have received the following titles for presentation at the Denver meeting. They have not, however, yet been approved by the Sectional Committee:

'A Summary of the Salient Effects due to the Secular Cooling of the Earth': Professor R. S. WOODWARD, Columbia University.

'The Energy of Condensation of Stellar Bodies': Professor R. S. WOODWARD.

'Supplementary Report on Non-Euclidean Geometry': Professor GEORGE BRUCE HALSTED, University of Texas.

'On the Application of the Fundamental Laws of Algebra to Infinite Series': Professor FLORIAN CAJORI, Colorado College.

'Conditionally Convergent Series whose Product is Absolutely Convergent': Professor FLORIAN CAJORI.

'Report on Continuous groups': Professor H. B. NEWSON, Kansas University.

'The Great Meteor of December 7, 1900': Professor H. A. HOWE, University of Denver.

'Note on a Direct Solution of Kepler's Problem': Professor H. A. HOWE.

'The Next Appearance of Eros': Professor H. A. HOWE.

'On Systems of Isothermal Curves': Professor L. E. DICKSON, University of Chicago.

'On the Modular Function Associated with the Irrationality $s^3 = z(z-1)(z-x)(z-y)$': Dr. J. I. HUTCHINSON, Cornell University.

'The Physical Bases of Long-Range Seasonal Forecasts': Professor CLEVELAND ABBE, U. S. Dept. of Agriculture, Weather Bureau.

'Philosophy of Mathematics': Professor W. J. KERR, Agricultural College of Utah.

'Astronomy in the High Schools': MISS MARY PROCTOR, New York City.

'Concerning (*a*) the Concept of *n*-Dimensional Space and (*b*) Self-Reciprocal Geometries': C. J. KEYSER, Columbia University.

'On the Probable Densities of the Satellites of the Solar System': Professor T. J. J. SEE, U. S. Naval Observatory.

'Photometric Observations of Eros': HENRY M. PARKHURST, New York City.

'The History of Several Fundamental Theorems in the Theory of Groups of Finite Order': Dr. G. A. MILLER, Cornell University.

SECTION F. ZOOLOGY.

Professor Henry B. Ward, secretary, has sent the following circular letter to members of the section:

The next meeting of the A. A. A. S. will be held in Denver, Colorado, August 24th to 31st, 1901. The opportunity is good for bringing together a large number of zoologists and making the meeting particularly interesting.

A provisional program of papers to be read before Section F will be printed within a short time and all members are urged to send titles as soon as practicable.

Permit me to call your attention to Article 28 of the constitution which designates how the sectional committee shall complete the final program from abstracts of papers presented. Kindly conform to the conditions as given there. I enclose blanks for titles and abstracts of papers.

The work of section F would be much strengthened if a larger number of the morphologists of the country were enrolled in its membership. Now that each member of the association receives gratis the official journal, SCIENCE, it is certainly true that no one can afford to be without membership in the organization.

Will not each present member assist in the work of enlarging the membership roll?

CONVOCATION WEEK.

IT will be remembered that, at the instance of a committee of the American Association for the Advancement of Science, the Association of American Universities recently took action recommending that a convocation week be set aside for the meetings of scientific and learned societies. Columbia University, Cornell University, the Catholic University of America, Clark University and Johns Hopkins University have altered their calendars, so that exercises will not be held during the week in which January 1 falls. The schedules of California, Leland Stanford Junior, Michigan and Yale are already such that no exercises fall in this week. Pennsylvania and Princeton have arranged to permit all instructors who wish to attend the meetings held during convocation week to do so, and it is expected that they will alter their official calendars next year. The faculty of the University of Wisconsin has voted to lengthen the Christmas holidays so that convocation week will be left free till 1905; this action will doubtless be confirmed by the regents and made permanent. The only members of the Association of American Universities, whose sessions begin during the week above mentioned and which has not yet taken action are Harvard and Chicago. It is to be hoped, may we not say expected, that all the institutions of the United States and Canada will give their support to this important movement.

SCIENTIFIC NOTES AND NEWS.

THE HON. CHARLES D. WALCOTT, director of the U. S. Geological Survey, gave an address before the University of Chicago on June 17, his subject being 'The Relations of the National Government to Higher Education and Research.' We hope to publish this address next week.

DR. PAUL C. FREER, professor of general chemistry in the University of Michigan, has been granted leave of absence for one year to go to Manila on an important scientific commission on behalf of the Philippine Commissioners.

DR. WILLIAM Z. RIPLEY, of the Massachusetts Institute of Technology, has been invited to deliver the Second Huxley Memorial Lecture before the Anthropological Institute of Great Britain. The first lecture was given last year by Lord Avebury.

PROFESSOR BASHFORD DEAN, who is now working at the Misaki Marine Station of the Imperial University of Tokio, has presented a yacht, with a complete outfit for marine zoological work, to the institution.

THE Society of Arts, London, has awarded the Albert medal to King Edward, who for thirty-eight years has acted as president of the society.

COLUMBIA UNIVERSITY at its recent commencement exercises conferred its newly established D.Sc. on Mr. Arnold Hague, of the U. S. Geological Survey. The degree of LL.D. was conferred on Dr. W. H. Maxwell, superintendent of the New York schools, and the degree of M.S. on the Rev. Frank D. Gamewell, professor of physics at the University of Pekin, and on Dr. G. M. Lefferts, clinical professor of laryngology in the College of Physicians and Surgeons of the University.

THE valuable contributions to entomology made by William H. Ashmead, of the U. S. National Museum, were recognized by the Florida Agricultural College and Experimental Station in Lake City, Fla., at its recent commencement by the conferment of the honorary degree of A.M.

DUBLIN UNIVERSITY will confer its D.Sc. on W. Burnside, professor of mathematics, Royal Naval College, Greenwich; W. E. Wilson, F.R.S., and Francis Joseph Edward Spring, C.I.E.

PROFESSOR H. S. CARHART has been appointed a delegate to the International Engineering Congress in Glasgow by the American Institute of Electrical Engineers. He has also been nominated as an honorary member of the Congress. He sails on August 13, and will attend both the Engineering Congress and the meeting of the British Association in Glasgow.

MR. F. W. HODGE has recently been appointed assistant in charge of office in the Smithsonian Institution, and to accept that appointment has resigned his position as ethnologist in the Bureau of American Ethnology. He continues as managing editor of the *American Anthropologist*.

DR. VICTOR C. VAUGHAN, of the University of Michigan, was elected president of the American Academy of Medicine at the annual meeting held in St. Paul, Minn., the first week in June.

DR. FREDERICK BEDELL, of Cornell University, will spend the coming year in Europe.

PROFESSOR J. CULVER HARTZELL, of the Illinois Wesleyan University, will be engaged during the summer in tracing certain partings in Indiana for the Indiana Geological Suruey.

PROFESSOR W. RAMSAY will lecture on the 'Inert Constituents of the Atmosphere,' and Professor Francis Darwin on 'The Movements of Plants,' at the approaching Glasgow meeting of the British Association.

PROFESSOR JAMES DEWAR gave the Bakerian Lecture before the Royal Society on June 13, his subject being 'The Nadir of Temperature and Allied Problems.'

THE William T. Lusk Memorial Science Prize has been awarded by the faculty of the University and Bellevue Hospital Medical College to S. S. Goldwater, for a paper entitled 'Notes on Blood Pressure in Man.' This prize is awarded to the member of the senior class presenting the best thesis which is the product of personal original research.

A MEMORIAL tablet to the late J. C. Porter, the botanist, was unveiled at Lafayette College in connection with the commencement exercises.

WE regret to announce the death of Professor Truman Henry Safford, which occurred at Williamstown, on June 13. Born at Royalton, Vt., in 1836, he had since 1876 occupied the chair of astronomy in Williams College.

DR. ARTHUR HAZELIUS, of Stockholm, the enthusiastic inspirer of the Northern Museum in that town, and the reviver of old Swedish customs, dances and costumes in the beautiful open-air museum known as Skansen, died on Whitmonday, mourned by all his countrymen.

M. MARÈS, known for his contributions to scientific agriculture, died at Montpelier, on May 9; Professor W. H. Heineke, for thirty-three years professor of surgery at Erlangen, has died at the age of sixty-six years.

JOHN VIRIAMU JONES, principal of, and professor of physics in, the University College of South Wales at Cardiff, died at Geneva on June

2. An obituary notice in the London *Times* states that he was born at Pontreporth, near Swansea, in 1856, he matriculated at London University in 1872, and won a University scholarship in geology, a subject in which he graduated as B.Sc. with first-class honors in 1875. In the preceding year he was elected Brackenbury scholar in natural science at Balliol College, Oxford; and in due course he was placed in the first class in mathematical moderations (1877), the final school of mathematics (1879), and the final natural science school (1880). For a short time he was demonstrator in the Clarendon Laboratory under Professor Clifton; but in 1881 he left Oxford to become principal of, and professor of mathematics and physics in, Firth College, Sheffield. Two years later, on the establishment of the University College of South Wales, he was appointed its first principal, also acting as professor of physics; and this position he retained up to his death. In 1894 he was chosen a fellow of the Royal Society, and in 1897 was elected a fellow of Jesus College, Oxford. His scientific work was mainly concerned with the measurement of electrical resistance, and he was a member of the committee of the British Association on that subject. In particular he was deeply interested in the determination of the standard ohm by the Lorenz method in absolute measure, *i. e.*, conditioned only by the units of length and time and the properties of the ether; he constructed a Lorenz apparatus for his laboratory at Cardiff, and took a prominent part in designing and testing another that was made in London for the McGill University. The cause of technical and scientific education in Wales owed much to his powers of organization, and he was vice-chairman of the Welsh Central Board for Intermediate Education, besides being the first Vice-chancellor of the University of Wales.

Dr. R. A. Daly, of Harvard University, has given up the plan of conducting a geological expedition to the North this summer.

Major Ronald Ross, of the Liverpool School of Tropical Medicine, expected to leave for Sierra Leone on June 8, in charge of the fifth malarial expedition from the school.

Alviso B. Stevens, assistant professor of pharmacy, in the University of Michigan, will spend a portion of the coming summer in New York City gathering old mortars, jars, shelf fixtures, etc., which will be made the nucleus of a collection illustrating the history of pharmacy.

A correspondent of the London *Times* states that Dr. Stein, writing from Khotan on April 22, reports the latest results of his excavations in northern Chinese Turkestan. He has unearthed a large number of fine stucco sculptures closely resembling the Greco-Buddhist relics of the northwestern Punjab, probably belonging to the first century of the Christian era. Great difficulty is being experienced in excavating the colossal Buddhas, but valuable photographs have been taken of them, while the smaller pieces have been removed. Dr. Stein has now a fine illustration of what the big Stupa with its chapel and court was like in Khotan at the time of the Han dynasty.

Professor William Patten, of Dartmouth College, has been granted leave of absence for the first semester of the next academic year. He will attend the International Congress of Zoologists in Berlin and afterwards explore the coast of the Baltic in Russia in search of specimens of *Cephalaspis* and other Ostracoderms. The United States Government, through its Geological Survey, has generously offered financial support in the undertaking. Dr. Patten's courses at Dartmouth will be given during his absence by Dr. J. H. Gerould.

Dr. Frank Russell has recently reported to the Bureau of American Ethnology a successful archeological trip through southeastern Arizona, in the course of which a number of hitherto unknown ruins were discovered and reconnoitered.

Professor W. H. Holmes recently returned from a visit to the South Carolina State College, at Columbia, where he supervised the arrangement and installation of the Babcock collection of stone implements. This collection, which represents the findings of the late Dr. Babcock during thirty years' residence in the district formerly occupied by the Catawba Indians, recently passed into the possession of the State; and it is now available for inspection, as well as for systematic study.

THE U. S. Biological Survey, Department of Agriculture, has sent an expedition to Athabasca and Great Slave Lakes. The chief object is the collection of information and specimens illustrating the geographic distribution of mammals, birds, trees and shrubs in the region. The expedition is in charge of Edward A. Preble. Last year Mr. Preble was sent to Hudson Bay on a similar mission.

REUTER'S correspondent in Berlin, telegraphing on June 1, says: The evening papers state that the international negotiations which have been proceeding with reference to the international protection of birds have now been concluded, and that the imperial chancellor has forwarded the draft of the international convention on this subject to the federal council with a recommendation that Germany should subscribe to it.

THE Chamber of Commerce of Cambridgeshire, has unanimously passed a resolution declaring that it is desirable for the British government to establish an official seed-testing station.

THE Antarctic exploring vessel *Discovery* left Dundee for London on June 3. A successor to Professor Gregory as leader of the scientific staff has not, we understand, yet been appointed.

THE Rockefeller Institute for Medical Research was incorporated in New York State on June 13. The directors for the first year, as we have already stated, are: William H. Welch, of Baltimore, T. Mitchell Prudden, C. A. Herter, L. Emmett Holt, and Hermann W. Biggs, of New York; Simon Flexner, of Philadelphia, and Theobald Smith, of Boston.

A COMMISSION, consisting of Sir T. Lauder Brunton, Dr. T. Stevenson, Mr. A. G. Salamon, Dr. A. P. Luff, Dr. Samuel Buckley and Mr. Fletcher Moulton, K.C., M.P., appointed by the Manchester Brewer's Central Association to investigate the causes of the beer poisoning that has recently occurred in Great Britain has made its report. The Commissioners say: "It is clear that the most frequent source of arsenical contamination in beer is the use of malt which has been kiln-dried or malted with improper fuel containing arsenic. At the same time the experience of the late outbreak has shown that precautions must be taken against the presence of arsenic in brewing sugars and other materials (except, perhaps, malt adjuncts) on account of the serious consequences of any carelessness in manufacture which might introduce arsenic. Accordingly, we have considered what steps should in future be taken by brewers to protect themselves from any repetition of the recent disasters. We recommend that brewers should make it a rule to require a written guarantee of freedom from arsenic with all purchases of brewing materials of every kind. In addition to this we recommend that brewers should from time to time test the purity of their beer in respect of arsenic. The fact that yeast has a special affinity for arsenic affords an excellent method of demonstrating the purity of the materials used. If the yeast be tested for arsenic, it will readily show whether the wort is contaminated, for it will be many times richer in arsenic than the wort itself. It thus forms an excellent indicator of the presence of arsenic. In addition to frequent testing of the yeast, it would be advisable for the brewers to take control tests from time to time of their brewing sugars, finings and other materials."

UNIVERSITY AND EDUCATIONAL NEWS.

THE bills in the Michigan Legislature to reduce the quarter-mill tax levied for the benefit of the university have been defeated. The annual income from this tax is now approximately $275,000, an increase over last year of $50,000.

THE alumni of the Massachusetts Institute of Technology have subscribed $100,000 for a gymnasium, to be erected as a memorial to the late President Walker. Over 15,000 former and present students have sent subscriptions.

COLUMBIA UNIVERSITY has received an anonymous gift of $100,000 for the establishment of a department for the study of Chinese institutions, language and history.

PRESIDENT PATTON announced at the commencement exercises of Princeton University that the authorities of the university had received $50,000 for an endowment fund for the library and $10,000 to establish a fellow-

ship in rhetoric. He also said that $150,000 of the $200,000 necessary for the erection of a new gymnasium had been insured by the alumni.

THE University of Chicago has received $3,000 by the will of Marie J. Mergier to establish a scholarship in physiology.

MRS. CAROLINE STANNARD TILTON, of New Orleans, has given $50,000 for a Tilton Memorial Library Building at Tulane University.

IT has now become known that Mr. and Mrs. James Speyer are the donors of the $100,000 for the experimental school of Teachers College, Columbia University. A site has been purchased near Amsterdam Avenue and 128th Street, and plans for the building, prepared by Mr. A. E. Josselyn, have been accepted.

LINCOLN COLLEGE and Decatur Industrial College have united, and will hereafter be called Milliken University, in recognition of a gift of $150,000 from Mr. James Milliken. Mr. A. R. Taylor has resigned the presidency of the State Normal College at Emporia, to become president of this institution.

THE faculty of the University of South Dakota decided, by practically a unanimous vote, several months ago, that there should hereafter be but one degree granted for all courses of work, *viz.*, the Bachelor of Arts. Heretofore there have been three degrees granted, Bachelor of Arts, Bachelor of Science and Bachelor of Philosophy. This step was taken independently of the similar action by the Universities of Michigan and Minnesota which we recently reported.

THE Yale Forest School has thirty-five applications for its summer session, which will be held next month at Milford, Pa.

A. D. COLE, professor of physics and chemistry in Denison University, has been called to a chair of physics in the Ohio State University. His position at Denison has been filled by the appointment of Professor Clark Chamberlin, of Colby College, Me.

W. G. TIGHT, professor of geology for thirteen years in Denison University, and editor of the *Bulletin of the Scientific Laboratories*, has been elected to the presidency and professorship of geology in the University of New Mexico.

H. C. MORENE, a fellow at Clark University, has been appointed assistant professor of mathematics in Leland Stanford University.

PROFESSOR F. C. FRENCH has resigned the chair of philosophy at Vassar College, and Dr. H. Heath Bawden has been appointed associate professor of philosophy in the institution.

FREDERICK E. BOLTON, PH.D. (Clark) has been promoted to the head of the department of pedagogy in the State University of Iowa, succeeding Professor J. J. McConnell who has resigned to accept the superintendency of schools at Cedar Rapids, Iowa.

PROFESSOR EUGENE HAANEL has resigned the chair of physics in Syracuse University to accept an appointment as superintendent of mines of Canada.

DR. SHEPHERD IVORY FRANZ, assistant in physiology in the Harvard Medical School, has been appointed instructor in physiology at Dartmouth College. He will give courses both in the Academic Department and in the Medical College.

DR. MARGARET FLOY WASHBURN, warden of Sage College, has been appointed to a lectureship in psychology in Cornell University.

PAUL GOODE, who has been head of the department of Geography at the Normal School, Charleston, Ill., since its foundation, has recently received the degree of Ph.D. from the University of Pennsylvania and has been appointed instructor in geography in the same institution.

DR. HERMAN C. COOPER, now of Lincoln, Nebraska, has been elected instructor in the department of chemistry of Syracuse University.

SANFORD BELL, a Clark University student, will be temporary instructor in psychology and pedagogy at Mount Holyoke College next year.

THE newly created third chair of zoology at the Imperial University of Tokio has been placed under the charge of Professor S. Watasé.

M. TH. RIBOT, professor of experimental and comparative psychology at the Collège de France and editor of the *Revue Philosophique*, will retire from his chair on a pension at the end of the present academic year.